AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.6.1.4 THE DISTANCE-TIME RELATIONSHIP

SCORE	PERCENTAGE
/189	%

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Q1.

(a) distance is a scalar and displacement is a vector

or

distance has magnitude only, displacement has magnitude and direction

1

(b) 37.5 km

accept any value between 37.0 and 38.0 inclusive

1

062° or N62°E

accept 62° to the right of the vertical

1

accept an angle in the range 60° −64°

accept the angle correctly measured and marked on the diagram

(c) train changes direction so velocity changes

1

acceleration is the rate of change of velocity

1

(d) number of squares below line = 17

accept any number between 16 and 18 inclusive

1

each square represents 500 m

1

distance = number of squares × value of each square correctly calculated − 8500 m

1

[8]

Q2.

(a) starting / stopping the stopwatch

human error is insufficient

reaction time is insufficient

or

timing over the smaller distances

accept not timing accurately

do not accept references to measuring distance incorrectly

1

(b) (i) before

1

(ii) increasing

accept accelerating

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it is not constant is insufficient
it is less than after four seconds is insufficient
it reaches a constant speed negates

1

(iii) calculate the gradient of the straight/steepest/constant section
accept gradient of any section after 5.5 seconds/30 cm

1

(iv) drag (force) increases (as the ball bearing gets faster)
accept frictional/upward force for drag

1

(until) drag (force) = weight
or
(until) resultant force is zero
accept upward force = downward force
accept till forces are balanced

1

(c) less than

1

ball bearing increases speed at a greater rate
accept it travels the same distance in less time

or
ball bearing has a greater acceleration
accept the ball bearing is going faster

or
terminal velocity has not been reached

1

so resultant force must be greater
or
as weight is the same (the drag must be less)
accept warmer oil has a lower density/viscosity for 1 mark if neither of the two reason marks score

1

[9]

Q3.

(a) (i) 3000 N

1

(ii) air resistance

1

(b) (i) the gradient of the sloping line

1

(ii) the area under the graph

1

(iii) horizontal line above previous one

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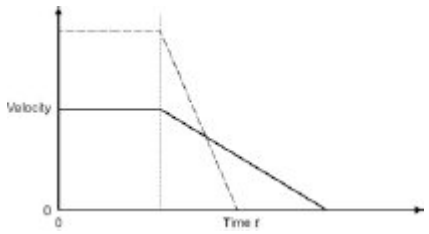
1

for the same time

1

sloping line cutting time axis before previous line

eg



1

(c) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1−2 marks)
One factor is given that affects thinking distance
or
one factor is given that affects braking distance

Level 2 (3−4 marks)
One factor and a description of its effect is given for **either** thinking distance **or** braking distance

Level 3 (5−6 marks)
One factor and a description of its effect is given for **both** thinking distance and braking distance
plus
some extra detail

Examples of the points made in the response
stopping distance = thinking distance + braking distance

the faster the car travels the greater the stopping distance

thinking distance is the distance travelled from when the driver sees an obstacle to when the brakes are applied

braking distance is the distance travelled from when the brakes are applied to when the car stops

thinking distance:
- tiredness increases thinking distance
- taking drugs increases thinking distance
- drinking alcohol increases thinking distance
- distractions in the car increase thinking distance.

braking distance:
- poor condition of brakes increases braking distance

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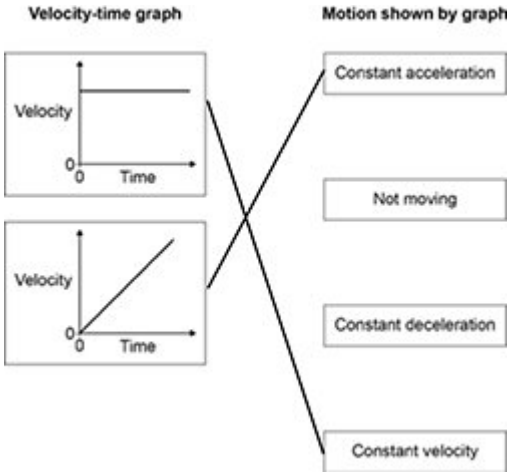
- poor condition of tyres increases braking distance
- wet roads increase braking distance
- icy roads increase braking distance.

6

[13]

Q4.

(a)



*if more than one line is drawn from a graph then all those lines are wrong allow **1** mark for 1 correct line*

2

(b) speed

1

(c) (i) 2.25

*allow **1** mark for correct substitution i.e.*

$a = \frac{9 - 0}{4}$ or $a = \frac{9}{4}$

provided no subsequent step

2

(ii) the air resistance increases

1

(d) 2000 J

1

mass is half
or
kinetic energy depends on mass

*do **not** accept weight for mass*

1

[8]

Q5.

(a) (i) decreases (to zero)

1

resultant force acts in opposite direction to motion

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accept air resistance and weight for resultant force
accept resultant force acts downwards
*do **not** accept air resistance increases*

1

(ii) velocity includes direction
or
velocity is a vector (quantity)

1

(b) (i) 3.6

allow 1 mark for correct substitution i.e.
½ × 0.05 × 12^2 provided no subsequent step

2

(ii) 3.6 **or** their (i)

1

(iii) 7.2
or
their (ii) ÷ 0.5 correctly calculated

*allow **1** mark for correct substitution i.e.*
3.6 or their (ii) = 0.05 × 10 × h

2

(iv) **B**

1

(c) range increases up to 45°

1

range decreases from 45°

the range is a maximum at 45° gains both marks
for any two angles that add up
to 90° the range is the same gains both marks
*the range increases then decreases gains **1** mark*

1

[11]

Q6.

(a) (i) 100 (m)

1

(ii) stationary

1

(iii) accelerating

1

(iv) tangent drawn at *t* = 45 s

1

attempt to determine slope

1

speed in the range 3.2 – 4.2 (m / s)

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dependent on 1st marking point

1

(b) (i) 500 000 (J)

ignore negative sign

1

(ii) 20 000 (N)

ignore negative sign
*allow **1** mark for correct substitution, ie*
500 000 = F × 25
***or** their part (b)(i) = F × 25*
provided no subsequent step

2

(iii) *(kinetic) energy* transferred by heating

1

to the brakes

ignore references to sound energy
*if no other marks scored allow k.e. decreases for **1** mark*

1

[11]

Q7.

(a) (i) not moving

1

(ii) straight line from origin to (200,500)

ignore a horizontal line after (200,500)

1

(b) 35 000

*allow **1** mark for correct substitution, ie 14 000 × 2.5 provided no subsequent step*
an answer of 87 500 indicates acceleration (2.5) has been squared and so scores zero

2

[4]

Q8.

(a) (sound waves) which have a frequency higher than the upper limit of hearing for humans
or
a (sound) wave (of frequency) above 20 000 Hz

sound waves that cannot be heard is insufficient
a wave of frequency 20 000 Hz is insufficient

1

(b) 640

*an answer of 1280 gains **2** marks*
*allow **2** marks for the correct substitution*
ie 1600 × 0.40 provided no subsequent step

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*allow **2** marks for the substitution* $\frac{1600 \times 0.80}{2}$

provided no subsequent step

*allow **1** mark for the substitution 1600 × 0.80 provided no subsequent step*

*allow **1** mark for the identification that time (boat to bed) is 0.4*

3

(c) any **one** from:

- pre-natal scanning / imaging
- imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles

  accept heart

  *do **not** allow brain **or** lungs (either of these negates a correct answer)*
- Doppler scanning blood flow

1

(d) advantage

any **one** from:

- (images are) high quality or detailed or high resolution

  clearer / better image is sufficient
- (scan) produces a slice through the body
- image can be viewed from any direction

  allow images are (always) 3D / 360°
- an image can be made of <u>any</u> part (inside the body)

  allow whole body can be scanned
- easier to diagnose **or** see a problem (on the image)

1

disadvantage

any **one** from:

- (the X-rays used **or** scans) are <u>ionising</u>

  allow a description of what ionising is
- mutate cells **or** cause mutations **or** increase chances of mutations

  allow for cells:

  DNA / genes / chromosomes / nucleus / tissue
- turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells
- kill cells

  damage cells is insufficient
- shielding is needed

  can be dangerous (to human health) unqualified, is insufficient

1

[7]

Q9.

(a) **D – E**

reason only scores if D – E chosen

1

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shallowest slope / gradient

accept smallest distance in biggest time
accept longest time to travel the same distance
accept the line is not <u>as</u> steep
accept it is a less steep line
*do **not** accept the line is not steep*

1

(b) 80 000

*allow **1** mark for correct substitution, ie 16 000 × 5 provided no subsequent step shown*

2

(c) (i) <u>straight</u> line starting at origin

accept within one small square of the origin

1

passing through t = 220 and d = 500

1

(i) 186

accept any value between 180 and 188
accept where their line intersects given graph line correctly read ±4 s

1

[7]

Q10.

(a) **B**

reason only scores if B is chosen

1

gradient / slope is the steepest / steeper

answers must be comparative
accept steepest line
ignore greatest speed

1

(b) (velocity includes) direction

'it' refers to velocity

1

[3]

Q11.

(a) (i) 12

1

(ii) 0.2

*allow **1** mark for their (a)(i) ÷ 60 and correctly calculated*

1

m/s^2

accept correct unit circled in list
accept ms^{-2}

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*do **not** accept mps²*

1

(b) **B**

1

[4]

Q12.

(a) 48

*allow for **1** mark correct method shown, ie 6 × 8*

***or** correct area indicated on the graph*

2

(b) diagonal line from (0,0) to (6,48) / (6, their (a))

if answer to (a) is greater than 50, scale must be changed to gain this mark

1

horizontal line at 48m between 6 and 10 seconds

accept horizontal line drawn at their (a) between 6 and 10 seconds

1

[4]

Q13.

(a) 96

*allow **1** mark for correct substitution*

ie 80 × 1.2

2

newton or N

allow Newton

*do **not** allow n*

1

(b) (i) direction

1

(ii) velocity and time are continuous (variables)

answers must refer to both variables

accept the variables are continuous / not categoric

accept the data / 'it' is continuous

accept the data / 'it' is not categoric

1

(iii) **C**

1

velocity is not changing

*the **2** marks for reason may be scored even if **A** or **B** are chosen*

accept speed for velocity

accept speed is constant (9 m/s)

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*accept **not** decelerating*

*accept **not** accelerating*

accept reached terminal velocity

1

forces must be balanced

accept forces are equal

accept arrows are the same length / size

or

resultant force is zero

*do **not** accept the arrows are equal*

1

[8]

Q14.

(a) shallowest slope/ gradient

accept smallest distance in biggest time
accept longest time to travel the same distance
accept the line is not as steep
accept it is a less steep line
*do **not** accept the line is not steep*

1

(b) **A – B**

If 2 or 3 boxes are ticked no mark

1

(c) (i) 200 m

1

(ii) 20 s

*allow **1** mark for correctly identifying 60 s or 40 s from the graph*

2

(d) (i) straight line starting at origin

accept within one small square of the origin

1

passing through t = 200 and d = 500

1

(ii) 166

accept any value between 162 and 168
accept where their line intersects
given graph line correctly read ± 3 s

1

[8]

Q15.

(a) 60

1

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(b) $5\frac{1}{2}$ hours

must include unit

1

(c) 30

1

(d) 30 minutes or

$\frac{1}{2}$ hour

must include unit

1

(e) D **and** E

accept finish for E
accept correct numbers from axes with units

1

least steep part of the graph

accept covers smallest distance in a set time
accept only moves 5 km in 1 ½ hours (accept anything between 5 and 6)
ignore horse is tired

1

[6]

Q16.

(a) **Quality of written communication**

for correct use of term speed in all correct examples
Q ✓ Q ✗

1

*describes all 3 sections correctly for **2** marks*
*describes 2 or 1 section correctly for **1** mark*

max 2

A – **B** constant <u>speed</u>

*do **not** accept pace for speed*

B – **C** (has accelerated) to a higher (constant) <u>speed</u>

C – **D** goes back to original / lower (constant) <u>speed</u>

*allow for **1** mark, initial and final (constant) speeds are the same accept velocity for speed*
ignore reference to direction

(b) 62.5

allow answer to 2 s.f.
*allow **1** mark for drawing a correct triangle **or** for using two correct pairs of coordinates*
*allow **1** mark for correct use of y/x*
ignore units

3

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[6]

Q17.

(i) first statement must be accelerated

if it just accelerated then decelerates award 2 marks

1

final statement must be stationary

1

interim statement decelerates

1

(ii) direction is changing

1

[4]

Q18.

(i) C and D **or** D and C

accept CD
accept DC
accept answers in terms of time

1

(ii) any **one** from:

streamline position streamline clothes

accept crouched position
accept tight clothes
accept design of cycle
accept cycle slower

1

(iii) 0.5 hours **or** 30 minutes **or** 1800 seconds

***must** have unit*

1

(iv) speed = $\frac{\text{distance}}{\text{time (taken)}}$

accept any correct rearrangement
*accept s = d/t **or** v s/t*
accept velocity for speed

accept 

if subsequent use of  *correct*

1

(v) 16

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allow for mark for each of time = 3.5 hours
distance = 56km
allow e.c.f. from *part (a)(iii) if correctly used*

*an answer of 14 gains **2** marks*

*allow **1** mark for correct attempt to average the three sections*

3

[7]

Q19.

(a) (i) Constant speed

2

(ii) Accelerates to higher constant speed

1

(b) (i) Points correct (allow one major or two minor mistakes)
Line correct (for their points)

2

(ii) 5 m/s
or 5
gets 2 marks

or correct unit
gets 1 mark mark

3

(c) (i) 50 s or 50
gets 2 marks

or t = d/v
gets 1 mark

3

(ii) Line correct (of gradient 4 and spans 30 consecutive seconds)

1

(d) (i) 0.04 or 6/15
gets 2 marks

or a = v/t
gets 1 mark

3

[15]

Q20.

(a) (i) 3km [allow 2.9 to 3.1]
for 1 mark

1

(ii) 6.6 min [allow 6.5 to 6.8]
for 1 mark

1

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(b) can be in any units, 1.5 km/min, 1500 m/min, 25 m/s, 90 km/h
Sp = d/t
=12/8
=1.5
km/min

for 1 mark each (see marking of calculations)

4

[6]

Q21.

(a) (i) air resistance/drag/friction (or upthrust)
weight/gravitational pull/gravity

for 1 mark each

1

(ii) air resistance/friction acts in opposite direction to motion

1

(iii) Y

1

(iv) the sky-diver accelerates/his speed increases
in downward direction/towards the Earth/falls

for 1 mark each

2

(b) force X has increased force Y has stayed the same the speed of the sky-diver will stay the same

for 1 mark each

3

(c) (i) CD

1

(ii) 500
(iii) 50
} (but apply e.c.f. from (i))

3

(iv) 10 (but apply e.c.f. from (ii) and (iii))

gets 2 marks

or 500/50 or d/t

gets 1 mark

2

[14]

Q22.

(a) (i) 9400(m)

for 1 mark

1

(ii) 26.5(hours)

for 1 mark

1

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(b) (i) F

for 1 mark

1

(ii) D

for 1 mark

1

(iii) B

for 1 mark

1

[5]

Q23.

(a) (i) **E-F** (ticked)

1

(ii) **B-C or D-E**

accept both answers

1

(b) fast(er)

accept downhill

1

slow(er)

1

force

*do **not** accept distance*

1

[5]

Q24.

(a) (i) walking at constant speed

1

(ii) standing still

1

(b) is higher **or** faster

accept less time to walk more distance (both time and distance must be mentioned)

1

the slope of graph is steeper

accept slope is more

1

(c) speed = $\frac{\text{distance}}{\text{time}}$

accept suitable symbols used in correct formula

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do not accept a triangle

1

[5]

Q25.

(a) A = speeding up

[Accept 'accelerating / acceleration / going faster]

B =moving at a steady speed

[Accept 'constant speed']

C = slowing down

[Accept 'going slower' / decelerating]

each for 1 mark

3

(b) acceleration = $\frac{\text{change in speed/velocity}}{\text{time taken}}$

NB if formula given must be correct

or $\frac{10}{4}$

gains 1 mark

but 2.5

gains 2 marks

unit m/s^2 **or** metres per second squared
or metres per second per second

for 1 mark

or m/s^{-2}

[Credit even if no / an incorrect numerical answer is given]

3

[6]

Q26.

(a) evidence of

speed = $\frac{\text{distance}}{\text{time}}$ (travelled) or $\frac{100}{20}$ or $\frac{40}{20}$

gains 1 mark

but or any correct calculation of gradient

(except when zero) gains 2 marks

$\frac{140}{70}$ or 2

gains 1 mark

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units metres per second **or** m/s **or** ms^{-1}

(<u>not</u> mps)

for 1 mark

3

(b) *evidence of* calculating the two speeds

($\frac{100}{20}$ and $\frac{40}{20}$ **or** 5 and 2) (evidence of this may be in (a))

or

noting distances travelled in same time (20 secs) i.e. 100m and 40m **but** 2.5

gains 2 marks

2

[5]

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