AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.6.3 FORCES AND BRAKING (PACK 2)

SCORE	PERCENTAGE
/339	%

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Q1.

(a) induced

1

(b) bar 2

1

(the same end) of bar 1 attracts both ends of bar 2

or

only two magnets can repel so cannot be bar 1 or bar 3

1

(c) so the results for each magnet can be compared

or

so there is only one independent variable

fair test is insufficient

allow different thickness of paper would affect number of sheets each magnet could hold

accept it is a control variable

1

(d) because the magnet with the biggest area was not the strongest

accept any correct reason that confirms the hypothesis is wrong eg smallest magnet holds more sheets than the largest

1

[5]

Q2.

(a) the distance travelled under the braking force

1

(b) the reaction time will increase

1

increasing the thinking distance (and so increasing stopping distance)

(increases stopping distance is insufficient)

1

(c) No, because although when the speed increases the thinking distance increases by the same factor the braking distance does not.

1

eg

increasing from 10 m / s to 20 m / s increases thinking distance from 6 m to 12 m but the braking distance increases from 6 m to 24 m

1

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(d) If the sled accelerates the value for the constant of friction will be wrong.

1

(e) only a (the horizontal) component of the force would be pulling the sled forward

1

the vertical component of the force (effectively) lifts the sled reducing the force of the surface on the sled

1

(f) $-u^2 = 2 \times -7.2 \times 22$

award this mark even with 0^2 and / or the negative sign missing

1

u = 17.7(99)

1

18

1

*allow 18 with no working shown for **3** marks*

*allow 17.7(99) then incorrectly rounded to 17 for **2** marks*

[11]

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

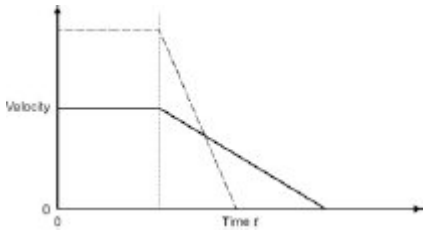
1

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.

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

6

[13]

Q4.

(a) (i) distance travelled under the braking force

accept distance travelled between applying the brakes and stopping

1

(ii) any **one** from:
- icy / wet roads

  accept weather (conditions)
- (worn) tyres
- road surface

  accept gradient of road
- mass (of car and passengers)

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accept number of passengers

- (efficiency / condition of the) brakes.

friction / traction is insufficient

1

(iii) greater the speed the greater the braking force (required)

must mention both speed and force

1

(b) 22.5

*allow **1** mark for showing correct use of the graph with misread figures*

or

for showing e.g. 90÷4

*an answer 17 gains **1** mark*

any answer such as 17.4 or 17.5 scores 0

2

(c) (i) momentum before = momentum after

or

(total) momentum stays the same

accept no momentum is lost

accept no momentum is gained

ignore statements referring to energy

1

(ii) 5

*allow **2** marks for correctly obtaining momentum before as 12 000*

or

*allow **2** marks for*

1500 × 8 = 2400 × v

or

*allow **1** mark for a relevant statement re conservation of momentum*

or

*allow **1** mark for momentum before = 1500 × 8*

3

(d) the seat belt stretches

1

driver takes a longer (*impact*) time to slow down and stop (than a driver hitting a hard surface / windscreen / steering wheel)

1

for the (same) change of momentum

accept so smaller deceleration / negative acceleration

1

a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt)

or

the seat belt stretches *(**1**)*

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do not accept impact for force

driver travels a greater distance while slowing down and stopping (than a driver hitting a hard surface / windscreen / steering wheel) ***(1)***

for (same) amount of work done ***(1)***

accept for (same) change of KE

a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt) ***(1)***

do not accept impact for force

1

[13]

Q5.

(a) increases

1

increases

1

(b) 23 (m)

*accept 43 circled for **1** mark*

*accept 9 + 14 for **1** mark*

2

(c) (i) all points correctly plotted

all to ± ½ small square

*one error = **1** mark*

*two or more errors = **0** marks*

2

line of best fit

1

(ii) correct value from their graph (± ½ small square)

1

(d) (i) 70

*½ × 35 × 4 gains **2** marks*

*attempt to estimate area under the graph for **1** mark*

3

(ii) line from (0.6,35)

1

sloping downwards with a less steep line than the first line

1

cutting time axis at time > 4.6 s

accept cutting x-axis at 6

1

(e) (i) 42 000

*1200 × 35 gains **1** mark*

2

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kgm / s

Ns

1

(ii) 10 500 (N)

*42 000 / 4 gains **1** mark*

alternatively:

$a = 35 / 4 = 8.75\ m / s^2$

$F = 1200 \times 8.75$

2

[19]

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)

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.

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(a) (i) gravitational potential (energy)

1

(ii) kinetic (energy)

1

(b) (i) slope or gradient

1

(ii) area (under graph)

*do **not** accept region*

1

(iii) starts at same y−intercept

1

steeper slope than original and cuts time axis before original

the entire line must be below the given line

allow curve

1

(c) (i) 31

and

31

*correct answers to 2 significant figures gains **3** marks even if no working shown*

*both values to more than 2 significant figures gains **2** marks:*
30.952…...
30.769….

65 / 2.1 and / or
*80 / 2.6 gains **1** mark*

*if incorrect answers given but if both are to 2 significant figures allow **1** mark*

3

(ii) student 1 incorrect because 80 ≠ 65

1

student 2 correct because average velocities similar

*ecf from **(c)(i)***

1

student 3 incorrect because times are different

1

[12]

Q8.

(a) time

correct order only

1

force

1

(b) The car tyres being badly worn

1

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(c) (i) braking distance increases with speed

accept positive correlation

*do **not** accept stopping distance for braking distance*

1

relevant further details, eg

- but not in direct proportion
- and increases more rapidly after 15 m/s

accept any speed between 10 and 20

accept numerical example

- double the speed, braking distance increases × 4

1

(ii) line drawn above existing line starting at the origin

as speed increases braking distance must increase
each speed must have a single braking distance

1

(d) (i) reaction time / reaction (of driver) does not depend on speed (of car)

1

(ii) (on the reduced speed limit roads) over the same period of time

accept a specific time, eg 1 year

1

monitor number of accidents before and after (speed limit reduced)

*allow **1** mark only for record number of vehicles / cars using the (20 mph) roads **or** collect data on accidents on the (20 mph) roads*

to score both marks the answer must refer to the roads with the reduced speed limit

1

[9]

Q9.

(a) (i) distance vehicle travels during driver's reaction time

accept distance vehicle travels while driver reacts

1

(ii) any **two** from:

- tiredness
- (drinking) alcohol
- (taking) drugs
- speed
- age

accept as an alternative factor distractions, eg using a mobile phone

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2

(b) (i) 320 000

*allow **1** mark for correct substitution, ie* $\frac{1}{2} \times 1600 \times 20^2$
provided no subsequent step shown

2

(ii) 320000 **or** their (b)(i)

1

(iii) 40

or

$\frac{\text{their (b)(ii)}}{8000}$ correctly calculated

*allow **1** mark for statement work done = KE lost*

or

*allow **1** mark for correct substitution, ie*
*8000 × distance = 320 000 **or** their (b)(ii)*

2

(iv) any **one** from:

- icy / wet roads
  accept weather conditions
- (worn) tyres
- road surface
- mass (of car and passengers)
  accept number of passengers
- (efficiency / condition of the) brakes

1

(v) (work done by) friction
(between brakes and wheel)

*do **not** accept friction between road and tyres / wheels*

1

(causes) decrease in KE and increase in thermal energy

accept heat for thermal energy accept
KE transferred to thermal energy

1

(c) the battery needs recharging less often

accept car for battery

1

or
increases the range of the car

*accept less demand for other fuels **or** lower emissions **or** lower fuel costs*
environmentally friendly is insufficient

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as the efficiency of the car is increased

accept it is energy efficient

1

the decrease in (kinetic) energy / work done charges the battery (up)

accept because not all work done / (kinetic) energy is wasted

1

[14]

Q10.

(a) gravitational / gravity / weight

*do **not** accept gravitational potential*

1

(b) accelerating

accept speed / velocity increases

1

the distance between the drops increases

1

but the time between the drops is the same

accept the time between drops is (always) 5 seconds
accept the drops fall at the same rate

1

(c) (i) any **one** from:

- speed / velocity
- (condition of) brakes / road surface / tyres
- weather (conditions)

accept specific examples, eg wet / icy roads
accept mass / weight of car friction is insufficient
reference to any factor affecting thinking distance negates this answer

1

(ii) 75 000

*allow **1** mark for correct substitution, ie 3000 × 25 provided no subsequent step shown*
***or** allow **1** mark for an answer 75*
***or** allow **2** marks for*
75 k(+ incorrect unit), eg 75 kN

2

joules / J

*do **not** accept j*
*an answer 75 kJ gains **3** marks*
for full marks the unit and numerical answer must be consistent

1

[8]

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Q11.

(a) more streamlined

accept decrease surface area

1

air resistance is smaller (for same speed)

accept drag for air resistance

friction is insufficient

1

so reaches a higher speed (before resultant force is 0)

ignore reference to mass

1

(b) (i) 1.7

*allow **1** mark for correct method, ie* $\frac{17}{10}$

***or** allow **1** mark for an answer with more than 2 sig figs that rounds to 1.7*

***or** allow **1** mark for an answer of 17*

2

(ii) 7.5

*allow **1** mark for correct use of graph, eg* $\frac{1}{2} \times 5 \times 3$

2

(iii) air (resistance)

accept wind (resistance)

drag is insufficient

friction is insufficient

1

[8]

Q12.

(a) 96 (m)

1

(b) (i) similar shape curve drawn <u>above</u> existing line going <u>through (0,0)</u>

*allow **1** mark for any upward smooth curve or straight upward line <u>above</u> existing line going through (0,0)*

2

(ii) Rain on the road

1

(c) (i) all three lines correctly labelled

*allow **1** mark for one correctly labelled*

top line – **C**

accept 1.2

middle line – **B**

accept 0.9

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bottom line – **A**

accept 0.7

2

(ii) any **two** from:

- (table has) both variables are together
  accept tired and music as named variables
- both (variables) could / would affect the reaction time
  accept cannot tell which variable is affecting the drive (the most)
- cannot tell original contribution
- need to measure one (variable) on its own
  accept need to test each separately
- need to control one of the variables
  fair test is insufficient

2

[8]

Q13.

(a) (i) longer reaction time

accept slower reactions

*do **not** accept slower reaction time unless qualified*

or

greater thinking distance

accept greater thinking time

or

greater stopping distance

accept greater stopping time

greater braking distance negates answer

1

(ii) lines / slopes have the same gradient

accept slopes are the same

or

velocity decreases to zero in same time / in 2.6 seconds

accept any time between 2.4 and 2.8

accept braking distances are the same

1

(iii) 12

*accept extracting both reaction times correctly for **1** mark (0.6 and 1.4)*

or

*time = 0.8 (s) for **1** mark*

*accept 0.8 × 15 for **2** marks*

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*accept calculating the distance travelled by car **A** as 28.5 m*
or
*the distance travelled by car **B** as 40.5 m for **2** marks*

3

(b) **Z**

1

different force values give a unique / different resistance

*only scores if **Z** chosen*

*do **not** accept force and resistance are (directly) proportional*

*accept answers in terms of why either **X** or **Y** would not be best eg*

***X** – same resistance value is obtained for 2 different force values*

***Y** – all force values give the same resistance*

1

[7]

Q14.

(a) any **two** from:

- (acceleration occurs when) the direction (of each capsule) changes
- velocity has direction
- acceleration is (rate of) change of velocity

2

(b) to(wards) the centre (of the wheel)

1

(c) the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)

accept 'the size' for radius
both parts required for the mark

1

[4]

Q15.

(a) **A** constant speed / velocity

accept steady pace

*do **not** accept terminal velocity*

*do **not** accept stationary*

1

B acceleration

accept speeding up

1

C deceleration

accept slowing down

accept accelerating backwards

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accept accelerating in reverse

*do **not** accept decelerating backwards*

1

(b) (i) the distance the car travels under the braking force

accept braking <u>distance</u>

1

(ii) speed/velocity/momentum

1

(c) (i) 5000 (N) to the left

***both** required*

accept 5000(N) with the direction indicated by an arrow drawn pointing to the left

accept 5000(N) in the opposite direction to the force of the car (on the barrier)

accept 5000(N) towards the car

1

(ii) to measure/detect forces exerted (on dummy / driver during the collision)

1

(iii) 4

*allow **1** mark for showing a triangle drawn on the straight part of the graph*

***or** correct use of two pairs of coordinates*

2

m/s^2

*do **not** accept mps^2*

1

[10]

Q16.

(a) The driver has been drinking alcohol.

reason only scores if this box is ticked

1

driver's reaction time increases

accept slower reactions

accept slower reaction time

or

thinking distance / stopping distance increases

do not accept braking distance increases

or

driver less alert

accept driver may fall asleep / be tired

1

(b) they are all variables that could affect outcome / results

accept specific effect of changing one of the variables

accept to make the test valid

ignore reliable

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1

so data / barriers can be compared

accept to see which is / works best / safest

*do **not** accept fair test on its own*

1

(c) ticks in both the top <u>and</u> middle boxes

1

[5]

Q17.

(a) 4.2

*2 marks for correct substitution **and** transformation, ie 1155/275*

*allow **1** mark for correct resultant force with a subsequent incorrect method, ie 1155*

*allow **1** mark for an incorrect resultant force with a subsequent correct method,*

*eg answers of 7.27 or 10.34 gain **1** mark*

3

(b) (i) YES

marks are for the explanation

any **two** from:

- data (from police files) can be trusted
- data answers the question asked

  allow a conclusion can be made from the data
- large sample used

NO

any **two** from:

- the sample is not representative
- the sample size is too small
- accident files do not indicate age / experience of riders

  *an answer YES and NO can score **1** mark from each set of mark points*

2

(ii) more accidents with motorbikes up to 125 cc

*accept for **2** marks an answer in terms of number of under 125 cc to accidents ratio compared correctly with number of over 500 cc to accidents ratio*

1

even though there are fewer of these bikes than bikes over 500 cc

1

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(c) (i) increases the time taken to stop

accept increases collision time

1

decreases rate of change in momentum

accept reduces acceleration / deceleration

accept $F = \frac{\Delta mv}{\Delta t}$

reduces momentum is insufficient

1

reduces the force (on the rider)

1

(ii) YES

any sensible reason, eg:

the mark is for the reason

- cannot put a price on life / injury

  accept may save lives

- fewer (serious) injuries

  accept reduces risk of injury

- reduces cost of health care / compensation

NO

any sensible suggestion, eg:

- money better spent on …

  needs to be specific

- total number of riders involved is small

1

[11]

Q18.

(a) distance travelled under the braking force

accept braking (distance)

1

(b) (directly) proportional

accept a correct description using figures

or

increase in the same ratio

eg if speed doubles then

thinking distance doubles

*accept for **1** mark positive correlation*

*accept for **1** mark as speed*

increases so does thinking distance

accept as one increases the other increases

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accept as thinking <u>distance</u> increases speed increases

2

(c) (i) control variable

1

(ii) experiment done, student listens to music / ipod (etc)

1

experiment (repeated), student not listening to music

for both marks to be awarded there must be a comparison

1

(d) increase it

accept an answer which implies reactions are slower

*do **not** accept answers in terms of thinking distance only*

1

(e) **Y**

1

[8]

Q19.

(a) (i) longer reaction time

accept slower reactions

*do **not** accept slower reaction time unless qualified*

or

greater thinking distance

accept greater thinking time

or

greater stopping distance

accept greater stopping time

greater braking distance negates answer

1

(ii) lines / slopes have the same gradient

accept slopes are the same

or

velocity decreases to zero in same time / in 2.6 seconds

accept any time between 2.3 and 2.8

accept braking distances are the same

1

(iii) 12

*accept extracting both reaction times correctly for **1** mark (0.6 and 1.4) **or** time = 0.8(s) for **1** mark*

*accept 0.8 × 15 for **2** marks*

*accept calculating the distance travelled by car **A** as 28.5 m **or** the distance travelled by car **B** as 40.5 m for **2** marks*

3

(b) **Z**

1

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different force values give a unique / different resistance

*only scores if **Z** chosen*

*do **not** accept force andresistance are (directly) proportional*

accept answers in terms of why

*either **X or Y** would not be the best eg*

***X** – same resistance value is obtained for 2 different force values*

***Y** – all force values give the same resistance*

1

[7]

Q20.

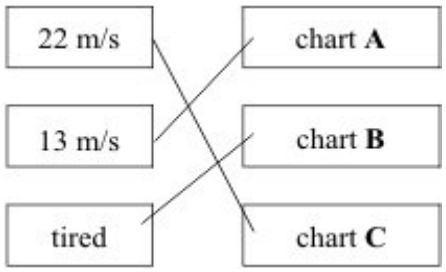
(a) (i) constant

1

(ii) heat

1

(b) (i) 3 links correct



*allow **1** mark for 1 correct link*

if more than one line is drawn from a condition mark all lines from that condition incorrect

2

(ii) increased

1

[5]

Q21.

(a) 53 (m)

1

(b) (i) Similar shape curve drawn <u>above</u> existing line going <u>through (0, 0)</u>

*allow **1** mark for any upward smooth curve or straight upward line above existing line going through (0, 0)*

2

(ii) rain on road

1

car brakes in bad condition

1

(c) (i) all three lines correctly labelled

*allow **1** mark for one correctly labelled*

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top line – C

accept 1.2

middle line – B

accept 0.9

bottom line – A

accept 0.7

2

(ii) any **two** from:

- (table has) both variables are together
  accept tired and music as named variables
- both (variables) could/ would affect the reaction time
- cannot tell original contribution
  accept cannot tell which variable is affecting the drive (the most)
- need to measure one (variable) on its own
  accept need to test each separately
- need to control one of the variables

2

[9]

Q22.

(a) (i) as one goes up so does the other

or (directly) proportional

accept change by the same ratio

1

(ii) steeper straight line through the origin

judge by eye

1

(iii) Yes with reason

eg data would have been checked / repeated
accept produced by a reliable/ official/ government source
*do **not** accept it needs to be reliable*

or No with reason

eg does not apply to all conditions / cars / drivers

or are only average values

or Maybe with a suitable reason

eg cannot tell due to insufficient information

1

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(b) (i) stopping distance = thinking distance + braking distance

1

(ii) any **two** from:

factors must be to do with increasing braking distance

- smooth road / loose surface
- rain / snow / ice

  accept wet road/ petrol spills
  *do **not** accept condition of road unless suitably qualified*
- badly maintained brakes

  accept worn brakes
  accept bad/ worn/ rusty brakes
  *do **not** accept old brakes*
- worn tyres

  accept bald tyres
  accept lack of grip on tyres
  *do **not** accept old tyres*
- downhill slope/gradient
- heavily loaded car

2

[6]

Q23.

(a) MN

accept 5.8, 8 seconds must include unit

1

(b) LM

accept 0.8, 5.8 seconds must include unit

1

(c) (i) 0.8

1

(ii) drinking alcohol

1

(d) <u>straight</u> (by eye) line starting at 0.8 seconds

1

line drawn steeper than LM starting before L

ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating

1

[6]

Q24.

(a) (i) <u>constant</u> speed

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*do **not** accept normal speed*
*do **not** accept it is stopped / stationary*

1

in a straight line

accept any appropriate reference to a direction
*constant velocity gains **2** marks*
*'not accelerating' gains **2** marks*
*terminal velocity alone gets **1** mark*

1

(ii) goes down owtte

accept motorbike (it) slows down

1

(b) (i) 20 (m/s)

ignore incorrect units

1

(ii) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

*do **not** accept velocity for change in velocity*
accept change in speed

accept $a = \frac{v - u}{t}$ ***or*** $a = \frac{v_1 - v_2}{t}$

or $a = \frac{\Delta v}{t}$

*do **not** accept* $a = \frac{v}{t}$

1

(iii) 4

or their (b)(i) ÷ 5

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

2

m/s^2

*m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second*

1

(c) vehicle may skid / slide

loss of control / brakes lock / wheels lock
*accept greater stopping distance **or** difficult to stop*

1

due to reduced friction (between tyre(s) and road)

accept due to less grip
*do **not** accept <u>no</u> friction*

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1

(d) any **three** from:

*do **not** accept night time / poor vision*

- <u>increased</u> speed
- <u>reduced</u> braking force
- <u>slower</u> (driver) reactions

  *NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc*
- <u>poor</u> vehicle maintenance

  *specific examples may **each** gain credit eg worn brakes or worn tyres etc*
- <u>increased</u> mass / weight of vehicle

  accept large mass / weight of vehicle
- <u>poor</u> road surface
- <u>more</u> streamlined

  *if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only*

3

[13]

Q25.

(a) points correct; line correct

for 1 mark each

2

(b) increases

for 1 mark

1

(c) (i) 9

for 1 mark

1

(ii) 6 ecf

for 1 mark

1

(iii) increased ecf

for 1 mark

1

[6]

Q26.

(a) Each scale optimum
Else both half size
Straight line joining 30,0 to 30,0.67 to 0, 5.67

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any 5 for 1 mark each

5

(b) 6
Else a = 30/5
gets 2 marks

Else a = v/t
gets 1 mark

3

(c) 9000
Else F = 6 × 1500
gets 2 marks

Else F = ma
gets 1 mark

3

(d) (i) Driver has forward momentum
Which is conserved
Giving drive relative forward speed to car
for one mark each

3

(ii) Car stops in 75m
gets 1 mark

W = F.d or 9000 × 75
gets 1 mark

W = 675 000 J
OR ke = 1/2 mv^2
gets 1 mark

ke = 1/2.1500.302
ke = 675 000 J

3

[17]

Q27.

(a) there is a (maximum) forward force
drag/friction/resistance (**opposes** motion) (**not** pressure)
increases with speed
till forward and backward forces equal
so no net force/acceleration
any 4 for 1 mark each

4

(b) (i) F = ma
10 000 = 1250a
a = 8
m/s^2
for 1 mark each

4

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(ii) $ke = 1/2\ mv^2$
$ke = 1/2\ 1250.48^2$
$ke = 1\ 440\ 000$
J

for 1 mark each

4

(iii) $W = Fd$
$W = 10\ 000.144$
$W = 1\ 440\ 000$
J

for 1 mark each

4

[16]

Q28.

(a) AB

for 1 mark

1

(b) (i) 0.7

for 1 mark each

1

(ii) 16.8

gains 2 marks

2

but correct working
(d = v.t, d = 24 × 0.7, or in terms of area under graph)

gains 1 mark

1

(c) $a = (v-u)/t$
$= 24/4$
$= 6$
m/s^2

(see marking of calculations)

(can work in terms of graph gradient)

4

(d) $d = v.t$
$= 24/2 \times 4$
$= 48$

(see marking of calculations)

(can work in terms of area under graph)

3

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(e) F = ma
= 800 × 6
= 4800

(see marking of calculations)

3

[15]

Q29.

(a) (i) tiredness / boredom
drugs
alcohol
distraction

any two for 1 mark each

2

(ii) A greater / longer
B no effect
C greater / longer

each for 1 mark

3

(b) on a wet road: there is less friction / grip

for 1 mark

braking distance is greater / takes longer to stop
or car skids / slides forward

for 1 mark

2

(c) (i) deceleration = gradient or 30 / 4.8

each for 1 mark

2

(ii) force = mass × acceleration or 900 × 6.25

each for 1 mark

2

(iii) distance = area under graph or 0.5 × 4.8 × 30 **or** average speed × time **or** 15 × 4.8
Accept answer in terms of change in k.e. = work done
if incorrect unit given (eg 72km) then no mark

each for 1 mark

2

[13]

Q30.

(a) WX deceleration / speed decreasing / slowing down / negative acceleration

XY constant speed / steady speed *not* constant motion / slow speed

YZ acceleration / speed increasing / speeding up

for 1 mark each

3

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(b) distance = v × t **or** distance = 30 × 20

gains 1 mark

but
distance = 600(m)

gains 2 marks

2

(c) acceleration = v / t **or** acceleration = 30 / 12

gains 1 mark
(if –30 / 12, allow negative sign here if not in the answer)

3

but
acceleration = 2.5 (m/s²)

gains 2 marks

but
acceleration = -2.5 (m/s²)

gains 3 marks

(d) in a crash / during hard braking car body stops / slows rapidly driver / passengers continue to move forward *not* thrown forward seatbelts provide backward force / keep them in their seats / restrain them to stop them hitting the windscreen / dashboard

(an alternative argument involving momentum is acceptable)
for 1 mark each

4

[12]

Q31.

(a) time

1

force

1

(b) any **three** from

- driver's reactions are slow(er)

  *accept driver could have taken drugs **or** alcohol **or** due to tiredness **or** distractions*

- poor weather conditions

  *accept raining **or** snowing **or** fog / mist (poor visibility)*

- greater mass **or** weight
- poor road conditions

  oil / gravel / mud / leaves / wet / icy going downhill

- poorly maintained brakes

  *do **not** accept driver's weak foot force*

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• worn tyres

3

[5]

Q32.

(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]

Q33.

(a) Any **three** factors from any of the

groups of factors below (1) each a clear and correct statement of the effect of the particular factor on the stopping distance (1) each

do not credit mobile phones do not credit other distractions

2

examples: (factors relating to the driver)
* (driver's) reaction time or time for the driver to apply the brakes
the longer the reaction time the longer the s.d.

which may be related to age, experience, sobriety, effect of drugs, mental capacity, physical capacity, driver fatigue, confusion and panic
does not depend on the driver's eyesight as this affects the occurrence of the 'need-to-stop' realisation rather than the stopping distance

examples: (factors relating to the car)

4

* force applied by the brakes the greater the force the shorter the s.d.
* speed (of the car) the greater the speed the longer the s.d.
* mass **or** weight (of the car) the greater the mass **or** weight the longer the s.d.
* ABS answers

examples: (factors relating to the road or tyres)

* tread on the tyres **or** friction the more tread **or** friction the shorter the s.d.
* slipperiness of the road the greater the slipperiness the longer the s.d.
* it is raining

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does not depend on the visibility as this affects the occurance of the 'need-to-stop' realisation rather than the stopping distance

(b) velocity

accept speed

1

mass

*accept weight **or** shape **or** aerodynamics*

do not credit size

1

(c) any **two** ((1) + (1)) each of

do not credit a description

* friction (between the tyres and the road) backwards or opposite to the direction of motion

do not credit the direction if the force not specified

* air resistance **or** drag **or** wind resistance backwards **or** opposite to the direction of motion

do not credit wind

* weight **or** gravity down (wards) **or** towards the centre of the Earth

*do not credit mass **or** inertia*

* reaction (of **or** from the road) upwards

4

(d) direction

allow bearing(s)

do not credit orientation

1

[13]

Q34.

(a) (i) the pushing force balanced by the friction

*accept the pushing force equals friction **or** pushing force is too small **or** frictional force is too great*

1

(ii) any **two** from

an unbalanced force acts on the model bus

the model bus moves

in same direction as pushing force

accept forwards

and will speed up

2

(iii) force (applied)

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any order

1

distance (moved)

1

(b) (i) car is travelling fast

1

driver has been drinking alcohol

1

ice on the road

1

(ii) tyres **and** road / ground

1

[9]

Q35.

(a) *evidence of* distance = speed × time **or** 4 × 20

gains 1 mark

but
80

gains 2 marks

units m

for 1 mark

3

(b) *idea that* (both) become warm/hot

for 1 mark

idea of wearing (away/down)/becoming scratched

gains 1 mark

but
(brake) pads wear more (than wheel discs)

gains 2 marks

3

[6]

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