AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.1.4 RESULTANT FORCES (PACK 1)

SCORE	PERCENTAGE
/250	%

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Q1.

(a) work done = 11 500 × 2.60

1

work done = 29 900 (J)

1

*an answer of 29 900 scores **2** marks*

(b) 13 800

1

(c) moment (of a force) = force × distance

allow M = F d

1

(d) 13 800 = 11 500 × distance

1

$$\text{distance} = \frac{13\,800}{11500}$$

1

distance = 1.2(0 m)

1

*of an answer 1.2(0) scores **3** marks*

[7]

Q2.

(a) arrow of equal size pointing vertically upwards

judged by eye
ignore horizontal arrows if equal and opposite
horizontal arrows of unequal length negates this mark

1

labelled 'upthrust'

ignore buoyancy
ignore 25 kN

1

(b) weight = 25 kN

allow 24 to 25 kN inclusive

1

25 000 = mass × 9.8
or

$$m = \frac{25000}{9.8}$$

allow their W correctly converted and substituted

1

m = 2551 kg

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allow correctly calculated value using their converted W
allow a value correctly calculated with W in kN

1

m = 2600 kg

allow a calculated answer correctly rounded to 2 significant figures

1

*an answer of 2600 scores **4** marks*

(c) Newton's 3rd law (of motion)

1

(d) vertical force (50 N) drawn
and
horizontal force (150 N) drawn to the same scale

1

resultant tension force in the correct direction
shown by an arrowhead

1

value of the tension force in the range 156 N−160 N
allow a calculated value of 158

1

value of direction in the range 18°−20° (from the horizontal)
allow 70° to 72° (from the vertical)
allow a bearing in the range 288 to 290

1

[11]

Q3.

(a) arrow vertically down – same size as lift – labelled weight
judge by eye

1

arrow to the left – same size as drag - labelled thrust
judge by eye
*two correct arrows without labels gains **1** mark*

1

(b) $34^2 - (0^2) = 2 \times 4.0 \times s$

1

$$\frac{34 \times 34}{8} = s$$

1

s = 144.5

1

s = 140 (2 sig figs)
*an answer of 140 scores **4** marks*
*an answer of 144.5 scores **3** marks*

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1

(c) tension force drawn to a suitable scale and in correct direction

1

triangle completed showing correct components

1

scale used to determine both component forces

1

horizontal component = 1900 N
vertical component = 680 N

allow 1850 to 1925 inclusive

allow 660 to 700 inclusive

1

[10]

Q4.

(a) D

1

(b) C

1

(c) W = 300 × 45

1

W = 13 500

1

*allow 13 500 with no working shown for **2** marks*

(d) straight line drawn from 13 m / s to 0 m / s

1

finishing on x-axis at 65 s

1

[6]

Q5.

(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

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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

(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]

Q6.

(a) resultant force = zero
or
upward force = downward force

accept forces are balanced

accept weight for downward force

1

(b) (i) 84

*allow **1** mark for correct substitution ie $840 = m \times 10$*

2

(ii) 12

accept 12.02 for both marks

or

1010 ÷ their (b)(i) correctly calculated

*a resultant force of 1010 (N) gains **1** mark*

an answer 22(.02) gains 1 mark

2

m/s^2

accept m/s/s

1

[6]

Q7.

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(a) 3 (.0)

*allow **1** mark for correct substitution i.e. 25 × 0.12 provided no subsequent step*

2

(b) (i) elastic potential

correct order only

1

kinetic

1

(ii) increases

1

to 80 (mm) (or more)

accept any number greater than 75

an answer 'it (more than) doubles' gains both marks

1

(c) (i) weight

1

(ii) downward speed increases

1

[8]

Q8.

(a) (i) D

1

(ii) friction

1

(iii) any **two** from:

- the speed / velocity
- the radius of the bend

the radius is insufficient

accept curvature of the road

size of the bend is insufficient

accept distance of car from centre (of bend)

- the mass (of the car).

accept weight for mass

2

(b) the car has a wide base

accept any description of a wide base e.g. the wheels are far apart

accept wide wheel base

*do **not** accept long wheel base*

a large surface area is insufficient

wide tyre(s) is insufficient

1

the car has a low centre of mass / gravity

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accept any description of low centre of mass e.g. mass is close to the ground

a down force is insufficient

1

[6]

Q9.

(a) the forces are equal in size and act in opposite directions

1

(b) (i) forwards / to the right / in the direction of the 300 N force

answers in either order

1

accelerating

1

(ii) constant velocity to the right

1

(iii) resultant force is zero

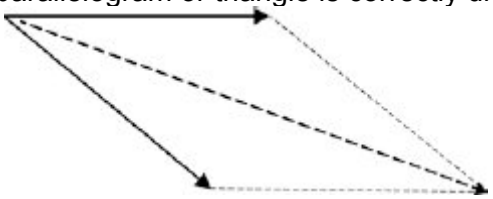
accept forces are equal / balanced

1

so boat continues in the same direction at the same speed

1

(iv) parallelogram or triangle is correctly drawn with resultant



3

value of resultant in the range 545 N – 595 N

*parallelogram drawn without resultant gains **1** mark*

If no triangle or parallelogram drawn:

*drawn resultant line is **between** the two 300 N forces gains **1** mark*

*drawn resultant line is between and longer than the two 300 N forces gains **2** marks*

1

[10]

Q10.

(a) (produces) a force from water on the boat

1

in the forward direction

accept in the opposite direction

this must refer to the direction of the force not simply the boat moves forwards

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*an answer produces an (equal and) opposite force gains **1** mark*

1

(b) (i) 1.5

*allow **1** mark for correct substitution, ie* $\frac{16-4}{8}$ ***or*** $\frac{12}{8}$
provided no subsequent step shown
ignore sign

2

m/s^2

1

(ii) 102
or
their (b)(i) × 68 correctly calculated
*allow **1** mark for correct substitution, ie 1.5 × 68*
***or** their (b)(i) × 68*
provided no subsequent step shown

2

(iii) greater than
reason only scores if greater than chosen

1

need to overcome resistance forces
accept named resistance force
accept resistance forces act (on the water skier)
*do **not** accept gravity*

1

[9]

Q11.

(a) 4 N to the right

1

(b) (i) bigger than

1

equal to

1

(ii) reduces it

1

increases air resistance / drag / force C
accept parachute has large(r) (surface) area

1

[5]

Q12.

(a) (i) electrons

1

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a positive

1

(ii) (forces are) equal

accept (forces are)the same

forces are balanced is insufficient

1

(forces act in) opposite directions

accept (forces) repel

both sides have the same charge is insufficient

1

(b) aluminium

1

[5]

Q13.

(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* $\frac{5}{3}$

***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

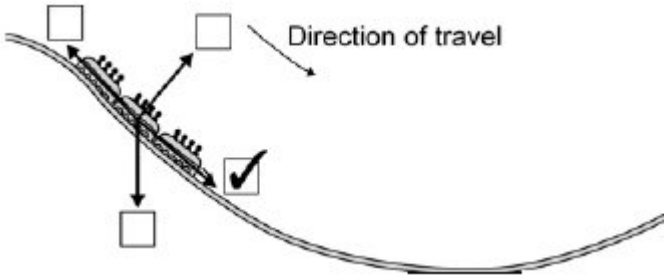
1

[8]

Q14.

(a) correct box ticked

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1

(b) (i) 30

ignore added units

1

(ii) 2250 **or** their (b)(i) × 75 correctly calculated

*allow **1** mark for correct substitution ie 75 × 30 **or** their (b)(i) × 75 provided no subsequent step shown*

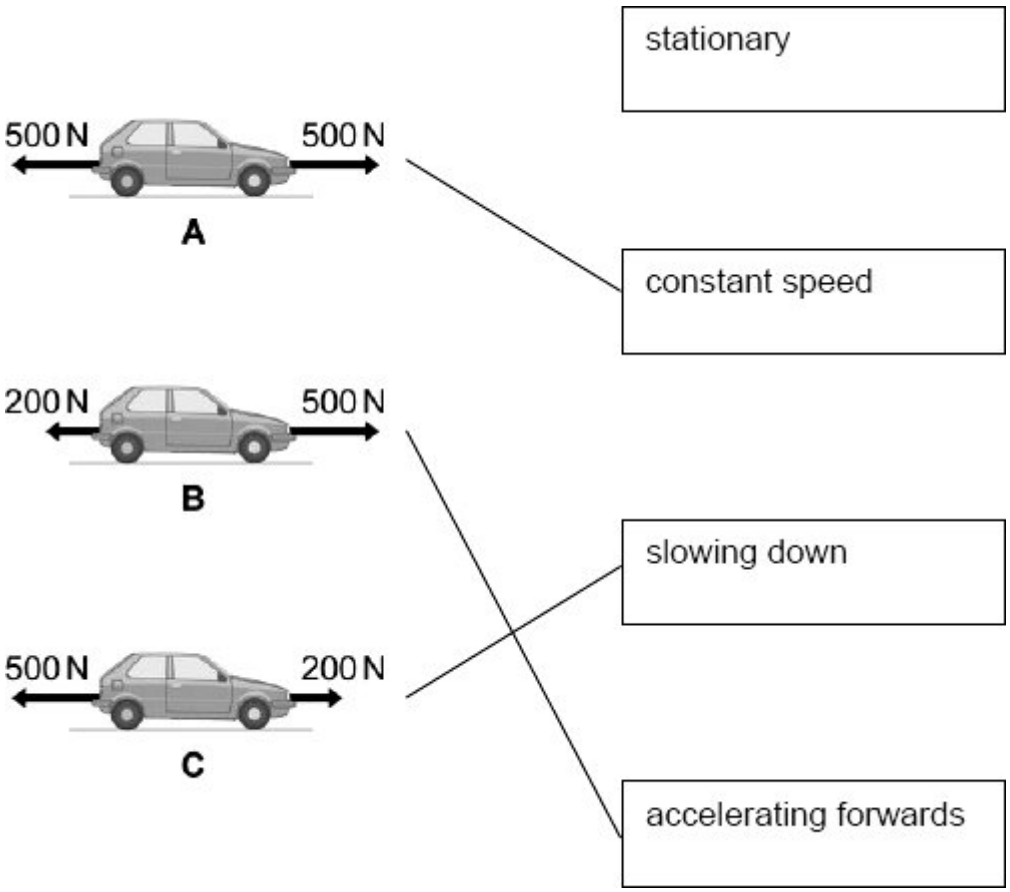
*an answer of 750 gains **1** mark only if answer to (b)(i) is 10*

2

[4]

Q15.

(a) *3 lines drawn*
all correct
*allow **1** mark for each correct line*
if two or more lines are drawn from any diagram then all these lines are incorrect



3

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(b) (i) horizontal arrow to the right

judge by eye

accept an arrow drawn outside the box if it is labelled correctly

1

(ii) horizontal arrow to the left

judge by eye

accept an arrow drawn outside the box if it is labelled correctly

1

(iii) equal to

1

(iv) to measure the forces exerted on the dummy during the impact

1

[7]

Q16.

(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

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)

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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]

Q17.

(a) (i) 120

1

(ii) 20

accept 140–their (a)(i) provided answer is not negative

1

(iii) as speed increases

1

drag force / water resistance / friction / **D** increases

1

(until) **D** = 140 N or (until) **D** = **T**

forces balance is insufficient

1

(b) (i) (average) speed (of swimmer)

1

(ii) any **two** from:

- more data
  accept results for data
  *do **not** accept more accurate data*
- force may vary (a lot) / change
- give more reliable average
  ignore references to anomalies
  ignore accurate / precise

2

(iii) examples of acceptable responses:

- most / some females produce smaller forces
  *do **not** accept all females produce smaller forces*
- most / some males produce larger forces
  *do **not** accept all males produce larger forces*
- some females swim as fast as males but use a smaller force

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- most of the faster swimmers are male
  *do **not** accept <u>all</u> males swim faster*
- most of the slower swimmers are female
  *do **not** accept <u>all</u> females swim slower*
- range of the (average) speed of males is smaller than the range of the (average) speed of females
- range of the (average) force of the males is greater than the range of the (average) force of the females

1

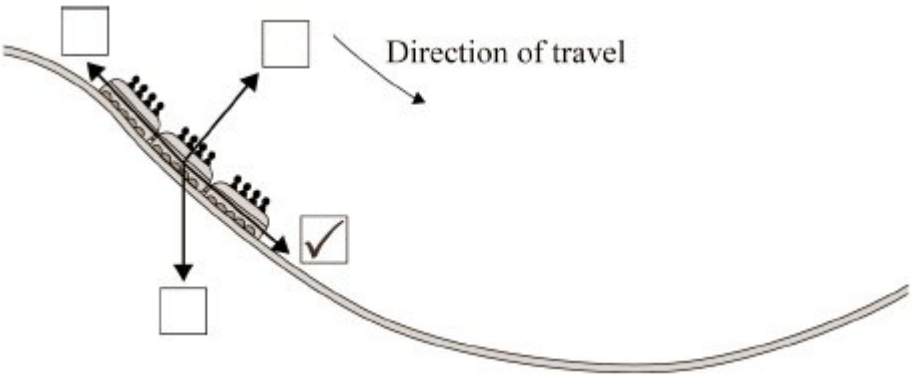
(iv) exert maximum (hand) force (throughout the swim / stroke)
accept (any method to) increase (hand) force
practise more is insufficient

1

[10]

Q18.

(a) correct box ticked



1

(b) each passenger has a different mass
accept weight for mass
ignore other irrelevant factors about the person e.g. mass and height
do not accept a list with incorrect factors e.g. mass and position
accept passengers started with different (gravitational) potential energy

1

(c) (i) 29.4
ignore added units

1

(ii) 2400
accept their (c)(i) × 80 correctly calculated for both marks
allow 1 mark for correct substitution of their (c)(i) and 80
an answer of 800 gains 1 mark only if answer to (c)(i) is not 10

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2

[5]

Q19.

(a) (i) 50 (N)

ignore any units

1

(ii) resultant force

1

(iii) 4000

*accept their (a)(i) × 80 correctly calculated for **2** marks*
*allow **1** mark for correct substitution i.e. 50 × 80 or their (a)(i) × 80*
ignore any units

2

(b) (i) joule

1

(ii) heat

1

[6]

Q20.

(a) gravity

accept weight
*do **not** accept mass*
accept gravitational pull

1

(b) (i) Initially force L greater than force M

accept there is a resultant force downwards

1

(as speed increases) force M increases

accept the resultant force decreases

1

when M = L, (speed is constant)

accept resultant force is 0
accept gravity/weighty for L
accept drag/ upthrust/resistance/friction for M
*do **not** accept air resistance for M but penalise only once*

1

(ii) terminal <u>velocity</u>

1

(iii) 0.15

accept an answer between 0.14 – 0.16
an answer of 0.1 gains no credit
*allow **1** mark for showing correct use of the graph*

2

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[7]

Q21.

(a) (i) a single force that has the same effect as all the forces combined

accept all the forces added / the sum of the forces / overall force

1

(ii) constant speed (in a straight line)

*do **not** accept stationary*

or constant velocity

1

(b) 3

*allow **1** mark for correct substitution into transformed equation*
*accept answer 0.003 gains **1** mark*
*answer = 0.75 gains **1** mark*

2

m/s^2

1

(c) as speed increases air resistance increases

accept drag / friction for air resistance

1

reducing the resultant force

1

[7]

Q22.

(a) (i) 0.6

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

2

newtons

accept N
*do **not** accept n*
accept Newtons

1

(ii) the same as

1

(b) (i) changed velocity

accept increased/ decreased for change
accept speed for velocity
accept change direction
accept getting faster/ slower
accept start/ stop moving
accept correct equation in terms of change in speed or change in velocity

1

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(ii) down(wards)

accept towards the ground

accept ↓

*do **not** accept south*

1

[6]

Q23.

(a) 4 (m/s)

***1** mark for correct transformation of either equation*
***1** mark for correct substitution with or without transformation*
***1** mark for correct use of 0.6N*

*max score of **2** if answer is incorrect*

3

(b) **greater** change in momentum

or greater mass of air (each second)

or increase in velocity of air

accept speed for velocity

force upwards increased

lift force is increased

*do **not** accept upthrust*

1

or force up greater than force down

accept weight for force down

1

(c) • increase the time **to stop**

1

• decrease rate of change in momentum or same momentum change

accept reduced deceleration/ acceleration

1

• reducing the force on the toy

*do **not** accept answers in terms of the impact/ force being absorbed*

*do **not** accept answers in terms of energy transfer*

*do **not** credit impact is reduced*

1

[8]

Q24.

(a) (i) friction

accept any way of indicating the correct answer

1

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(ii) gravity

accept any way of indicating the correct answer

1

(b) (i) accelerates **or** <u>speed</u> / velocity increases

accept faster <u>and</u> faster (1 mark)

*do **not** accept faster pace / falls faster*
or suggestions of a greater but constant speed

1

downwards / falls

accept towards the Earth / ground

this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts

1

(ii) constant speed / velocity **or** terminal velocity / speed or zero acceleration

stays in the same place negates credit

1

[5]

Q25.

(a) (i) accelerating

accept getting faster

accept speed / velocity increasing

1

(ii) acceleration <u>increases</u>

accept velocity / speed increases <u>more</u> rapidly
*do **not** accept velocity / speed increases*

1

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

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

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

*do **not** accept change in speed*

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

1

(ii) 15

*allow **1** mark for an answer of 900 **or** for <u>correct</u> use of 540 seconds*

2

(iii) velocity includes direction

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accept velocity is a vector (quantity)
accept converse answer

1

[6]

Q26.

(a) B

more aerodynamic **or** most streamlined shape **or**
smaller (surface) area

*accept less air/wind resistance **or** less drag **or** less friction*
*clothing traps less air **or** rolled up into ball **or** arms, legs drawn in*

accept converse

2

(b) (i) gravity

1

(ii) air resistance

1

(iii) go up

1

(iv) stays the same

1

(c) bigger the area, the bigger force Y

accept the converse

or bigger the area more drag

accept when the parachute opens then force Y bigger

or bigger the area more air resistance

need the relation of area to force

1

[7]

Q27.

(a) air(resistance) has greatest effect on paper

1

(b) paper **or** both fall faster

1

(both) fall together

*accept same speed **or** rate*

1

[3]

Q28.

(a) up

for 1 mark

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1

(b) (i) increased

for 1 mark

1

(ii) more water displaced; ship heavier

either for 1 mark

1

[3]

Q29.

(a) (i) plasticine stretches/snaps
stays stretched/snapped

for 1 mark each

2

(ii) spring compresses OWTTE
returns to **original** length/shape or gets longer

for 1 mark each

2

(iii) ruler bends/breaks
returns to original shape or stays broken

for 1 mark each

2

(b) (i) 1.5N

for 1 mark

1

(ii) 4 cm

for 1 mark

1

(iii) 19 cm

for 1 mark

1

[9]

Q30.

(a) plasticine stretches/snaps
stays stretched/snapped/same

for 1 mark each

2

(b) spring compresses OWTTE
returns to original length/gets longer

for 1 mark each

2

[4]

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Q31.

(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]

Q32.

(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

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(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]

Q34.

B and **D** (either order)

1

B and **D** (either order)

*accept **A** and **C***

1

A or **C**

1

[3]

Q35.

(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)

any order

1

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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]

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