GCSE
PHYSICS

Topic Paper: 1.1 & 5.6 Energy changes, power, work done, forces and motion
Part 1, 2 & 3 Mark Scheme

MARK SCHEME

117 Marks

M1. (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

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

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]

M2. (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]

M3. (a) acceleration = $\frac{\text{change in speed/velocity}}{\text{time taken}}$

or $\frac{10}{4}$

gains 1 mark
do not penalise if both of these present
but 'change in' omitted from formula

but
2.5

gains 2 marks

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

or metres per second per second

or ms^{-}*

for 1 mark

3

(b) *evidence* of using area under graph or distance average speed ×time
or

$10 \times 4 \times \frac{1}{2}$

gains 1 mark

but
20

gains 2 marks

units metres / m^{-2}*

for 1 mark

3

(c) force = mass ×acceleration **or** 75 ×25

gains 1 mark

but
1875

gains 2 marks

**NB Correct unit to be credited even if numerical answer wrong or absent.*

2

[8]

M4. (a) *any evidence of:* momentum = mass ×velocity (words, symbols or numbers)
appropriate re-arrangement mass as 0.05kg

each gains 1 mark

but 800

gains 4 marks

4

(b) (i) *any reference to* friction with air/air resistance

gains 1 mark

but *idea that* friction with air/air resistance is high (at high speed)

gains 2 marks

2

(ii) *any evidence of:* k.e. $\propto v^2$ **or** k.e. = ½ mv^2
$\frac{\text{final k.e.}}{\text{initial k.e.}}$
either initial or final k.e. correctly calculated (i.e. 16000; 10240)

each gains 1 mark

but $(0.8)^2$

gains 3 marks

but 64%(credit 0.64)

gains 4 marks (also credit e.c.f)

4

[10]

M5. (a) Each scale optimum
Else both half size
Straight line joining 30,0 to 30,0.67 to 0, 5.67

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) If inelastic ke lost
Here ke does work crumpling car
for 1 mark each

2

(iii) 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

[19]

M6. (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

(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]

M7. (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*
*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]

M8. (a) 13 500 (J)

*allow **1** mark for correct substitution, ie 90 x 10 x 15 provided no subsequent step shown*

2

(b) 17
or
$\sqrt{\frac{\text{their (a)}}{45}}$

correctly calculated and answer given to 2 or 3 significant figures

accept 17.3
*allow **2** marks for an answer with 4 or more significant figures, ie 17.32*
or
*allow **2** marks for correct substitution, ie 13 500/ their (a) = ½ x 90 x v^2*
or
*allow **1** mark for a statement or figures showing KE = GPE*

3

(c) work is done

1

(against) friction (between the miner and slide)

*accept 'air resistance' **or** 'drag' for friction*

1

(due to the) slide not (being perfectly) smooth

accept miners clothing is rough

or

causing (kinetic) energy to be transferred as heat/internal energy of surroundings

accept lost/transformed for transferred

accept air for internal energy of surroundings

1

[8]

M9. (a) 35 (m)

*allow **1** mark for indicating the correct area*

*allow **1** mark for obtaining correct figures from the graph*

*allow **1** mark for calculating area of triangle (25) but omitting the rectangle underneath (2 x 5)*

3

(b) 86 400

*allow **1** mark for correct substitution into the correct equation*

ie 1/2 ×1200 ×12 ^{2}

2

[5]

M10. (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]

M11. (a) 1.25

*allow **1** mark for correct resultant force ie 1500N*

*allow **2** marks for correct transformation and substitution*

ie $\frac{1500}{1200}$

*allow **1** mark for a correct transformation but clearly substituting an incorrect value for force*

eg = $\frac{3500}{1200}$

3

m/s^2

1

(b) as speed increases so does the size of the drag force

accept frictional force / resistive force / air resistance for drag

1

eventually the drag force becomes equal to the thrust

1

the resultant force is now equal to zero and therefore there is no further acceleration

1

(c) the car and van will reach top speed when the forward force equals the drag force

accept air resistance / frictional / resistive force for drag force

1

the drag force at any speed is smaller for the car than for the van

1

as the car is more streamlined

1

therefore the car's drag force will equal the forward force at a higher speed

1

allow converse throughout

[11]

M12. (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

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]