Mark schemes

1

(a) 47250

*answers of 1350/ 33750/ 48600 gain **1** mark*
*allow **1** mark for correct substitution using both 18 and 3*

2

(b) (i) 47250 or their (a)

accept statement 'same as the KE (lost)'
ignore any units

1

(ii) transformed into heat/ thermal energy

sound on its own is insufficient
accept transferred/ lost/ for transformed
*do **not** accept any other form of energy included as a list*

1

[4]

2

(a) $k = 1/2mv^2$
$k = 1/2.1.2.109.202$
$k = 2.4.1011$

for one mark each

3

(b) (i) 0.6.109

(ii) mass halved
speed halved
(speed)2 quartered
ke and/or power cut to one eight

for 1 mark each

5

[8]

3

(a) $p = mgh$
$= 50 \times 10 \times 4 = 2000$
J/Nm
(see marking of calculations)

4

(b) $k = ½\ mv^2$
$= ½ \times 50 \times 8^2$
$= 1600$
J/Nm
(see marking of calculations)

4

(c) work is done against air resistance
fall of her C of G differs from rise in climbing stairs
part of gained pe used to rotate body
diver gains PE on take-off

any 2 for 1 mark each

2

[10]

4 (a) (i) (connect) 30 (cells)

1

in series

1

(ii) current always flows in the same direction
or
current only flows one way

1

(iii) 36 000

*allow **1** mark for correctly converting 2 hours to 7200 seconds*
*answers 10 or 600 score **1** mark*

2

coulombs / C

*do **not** accept c*

1

(b) (i) 2160

*allow **1** mark for correct substitution, ie ½ × 120 × 6^2*
*answers of 1620 or 540 score **1** mark*

2

(ii) reduce it

1

any **one** from:

- draws a larger current (from battery)
- motor draws greater power (from battery)
  accept energy per second for power
  accept more energy needed to move the bicycle
- greater resistance force (to motion) / air resistance / drag / friction
  accept less streamlined
  more mass to carry is insufficient

1

[10]

5 (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]

6 (a) (i) linear scales used

do not credit if less than half paper used

1

points plotted correctly

all of paper used

1

(straight) line of best fit drawn

allow a tolerance of ± half square

1

(ii) correct **and** straight line through origin

all *needed*
e.c.f. if their (a)(i) is straight but not through the origin - incorrect because line does not go through origin
credit a calculation that shows proportionality

1

(iii) 62 ± 0.5 (m)

*credit **1** mark for KE = 490000 **or** 490kJ*
*credit **1** mark for correct use of graph clearly shown*

2

(iv) any **one** from: wet **or** icy **or** worn **or** smooth road

accept slippery slope

brakes worn

accept faulty brakes

car heavily loaded
worn tyres
downhill slope

do not accept anything to do with thinking distance e.g. driver tired or drunk

1

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

accept correct transformation

accept $\frac{v-u}{t}=a$

accept $m/s^2 = \frac{m/s}{s}$

*do **not** accept acceleration* $= \frac{velocity}{time}$

1

(ii) 56

accept –56

1

(iii) deceleration is reduced

accept deceleration is slower

accept acceleration

1

force on car and or passengers is reduced

accept an answer in terms of change in momentum for full credit

1

[11]

7 (a) 20 m/s

gets 2 marks

Else working

gets 1 mark

2

(b) 10 m/s

1

(c) 20 m

gets 2 marks

Else working

gets 1 mark

2

(d) 12 000 N

gets 2 marks

Else working

gets 1 mark

2

(e) 2 400 000 J

gets 2 marks

Else working

gets 1 mark

2

(f) (i) Ans to (e)

1

(ii) Ans to (e)/60

Else working

2

(iii) Ans to (ii)/5

1

[13]

8 (a) (i) work = force × distance

or *any correctly transposed version e.g.*

$$force = \frac{work}{distance}$$

or *in correct units throughout e.g.*

J = N × m

or *in acceptable abbreviations e.g.*

W = f × d

do not credit W = Nm ***or*** *any other*

ambiguous ***or*** *unclear response*

do not credit

unless subsequent calculation shows understanding

1

(ii) **EITHER**

3.7 (m)

2

OR

(distance =) $\frac{2000}{540}$

1

(iii) 2000 J

unit required

1

(b) **EITHER**

20

3

OR

speed^2 = 600 ÷ 1.5

or *speed*^{2} *= 600 ×* $\frac{2}{3}$

or *speed*^{2} *= 400*

or speed^2 *= KE ÷* $\frac{1}{2}$ *mass*

1

metres per second

or *m/s*

1

(c) any **three** from

deceleration (would be) (very) great

or rate of change of speed / velocity would be (very) great

(because) F = ma

or (because) force is proportional to deceleration / (negative) acceleration

(so the) force (on Susan / the rope) would be (very) great

do not credit she would be hurt

do not credit just the rope could snap

the rope may exceed its elastic limit

3

[10]

9 (a) product of mass and velocity

1

(b) (i) 4kg or 4000g

1

(ii) M = 8kgm/s or Ns

for 3 marks

else M = 8

for 2 marks

else M – mv or 4 × 2

for 1 mark

3

(iii) 8 kgm/s (watch e.c.f.)

1

(iv) v = 400

for 3 marks

else v = 8/0.02

for 2 marks

else M – mv, v – M/m or 8 = 0.02v

for 1 mark

3

(v) ke = 8

for 3 marks

else ke = 1/2 (4×2^2)

for 2 marks

else ke = 1/2 (mv^2)

for 1 mark

3

(vi) transferred to heat and sound
or does work against wood/pushing wood aside/deforming bullet

1

[13]

10 (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]

11 (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]