AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.2 WORK DONE AND ENERGY TRANSFER (PACK 2)

SCORE	PERCENTAGE
/134	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

(i) 700 or 686

gets 2

Else mg or 70 × 10 or 70 × 9.8 (1)

gets 1

2

(ii) 350J

gets 4

Else 350

gets 3

Else 700 × 0.5

gets 2

Else W = F.d.

gets 1

Any answer with unit J may score 1, 2 or 3 (see general instructions)

4

[6]

Q2.

(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

STEMUP.CO.UK

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]

Q3.

(a) W = 65 × 10
(*allow* a maximum of 3 marks if candidate uses g = 9.8N / Kg (as ecf))

gains 1 mark

but
W = 650 (N)
(*allow* use of p.e.= m × g × h)

gains 2 marks

but
PE change = 650 × 1.25 **or** 65 × 10 × 1.25

gains 3 marks

but
PE change = 812.5 (J) (*allow* 813J or 812J)

gains 4 marks

4

(b) k.e. = p.e.

gains 1 mark

but
$(\text{speed})^2 = 812.5 \times 2 / 65$ **or** $812.5 = ½ \times 65 \times (\text{speed})^2$ ecf

gains 2 marks

but
speed = 5 (m/s) (*allow* 4.99 → 5.002)

(if answer = 25mls check working: 812.5 = ½ m × v gains 1 mark for KE = PE)

(but if 812.5 = ½m × v^2 = ½ × 65 × v^2 or $v^2 = \frac{2 \times 812.5}{65}$ gains 2 marks)

25, with no working shown gains 0 marks

gains 3 marks

STEMUP.CO.UK

3

[7]

Q4.

(a) mass

1

(b) work (done) = force (applied) × distance (moved in the direction of the force)

*do **not** accept correctly substituted figures for this equation mark*
*accept W = Fs **or** W = Fd **or** W = Fh (well done) = force × height)*
mark formula independently

1

1 000 000 × 15

allow 1 000 000 × $\frac{15}{1000}$

1

= 15 000 000

= 15 000

1

J / joules

KJ / kilojoules

1

allow 1 000 000 × 1500
= 15 00 000 000 for 1 mark only – no unit mark
allow 3 marks for correct answer if no working / correct working is shown

(c) **Quality of written communication**
The answer to this question requires ideas in good English, in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme

Max.4 if ideas not well expressed

A – **B** not moving

*accept stationary **or** at rest*

1

B - C acceleration **or C** – **D** acceleration

accept increases speed / velocity accept gets faster

1

comparison made that the acceleration **B – C** is less than **C** – **D**

*accept comparison made that the acceleration **C-D** is greater than **B-C***

1

D – E constant velocity

STEMUP.CO.UK

*accept steady speed **or** at 0.4 m/s*

1

E – **F** deceleration

accept decreases speed / velocity
accept gets slower

1

[10]

Q5.

(a) the greater the mass / weight

1

then the greater the <u>kinetic energy</u>

accept the greater the momentum
accept greater mass / weight therefore greater force = 2

1

(b) (i)

<u>Note: this calculation requires candidates to show clearly how they work out their answer</u>

k.e. $\frac{1}{2}$ mv^2

accept evidence of equation

1

86 400 (J) at 12 m/s

*accept ½ × 1200 × 12^2 **or** 86.4 KJ*

1

194 400 (J) at 18 m/s

*accept ½ × 1200 × 18^2 **or** 194.4KJ*

1

increase in k.e. = 108 000
NB 10800 = 0 marks

N.B. if no working at all then max 3 for a correct numerical answer

1

joules **or J**

*accept 108 kilojoules **or** kJ*

1

(ii) explanation that ke $\propto$ v^2

1

[8]

Q6.

newton **or** N

metre **or** m

STEMUP.CO.UK

joules **or** J

all three correct 2 marks
two or one correct 1 mark

[2]

Q7.

8550

correct answer with no working = 3
if incorrect, allow 1 mark for work = force / weight × distance,
2 marks for = 1900 × 4.5

N.B. correct answer from the incorrectly recalled relationship
mass × distance = 2 marks

[3]

Q8.

12 100

correct answer with no working = 3
if answer incorrect, allow 1 mark for force = mass × acceleration
1210 × 10 = 2 force / weight = mass × gravity is neutral

N.B. no marks for correct answers with incorrectly recalled relationship

[3]

Q9.

900 000

correct with no working = 3 if answer incorrect, allow:

1 mark for K.E. = $\frac{1}{2}$ × *mass* × *speed*^{2}

2 marks for $\frac{1}{2}$ × 5000 × 600^2

N.B. correct answer with the incorrectly recalled relationship

$\frac{1}{2}$ × *weight* × *speed*^{2} = *2 marks*

[3]

Q10.

1050

4

kg

if answer incorrect then kinetic energy = $\frac{1}{2}$ mv^2 *or*
accept indication by correct substitution for 1 mark
accept 900 for 1 mark

STEMUP.CO.UK

accept $m = \frac{2KE}{v^2}$ *or indication by correct substitution for 1 mark*

1

[5]

Q11.

(a) **either**
gravity

1

due to mass of the Earth

or
(the) interaction / attraction between the (1)

mass of the block
and the mass of the Earth (1)

1

(b) (i) 4.5 N

unit required accept equal to weight (lifted)
do not credit ..mass..

1

(ii) the forces are balanced

accept because the block is not accelerating
accept because the block is moving at a steady speed (in a straight line) accept because the block's velocity is constant

1

(c) (i) **either**
4.05 J

3

or
work (done)
= force (applied)
× distance (moved in the
direction of the force)

or *work =4.5 ×0.9*
note '= 4.5 × 0.9' is not an equation

1

= 4.05

1

joules **or** J **or** newton metres

405 J will be a common answer
it gets (1) (for the unit) if correct equation is not shown but (2) otherwise
4.5 ÷ 0.9, ***or*** *variations on this theme, get (1) (for the unit) at most*

1

STEMUP.CO.UK

(ii) 4.05 J

or *same as the answer to (c) (i) provided that the same unit for energy is shown in both cases*

1

(d) 4.16

accept 4, 4.2, 4.17, 4.16

1

[10]

Q12.

(a) (i) work = force × distance

or *any correctly transposed version e.g.*

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

or *in correct units throughout e.g.*

$J = N \times m$

or *in acceptable abbreviations e.g.*

$W = f \times d$

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

$speed^2 = 600 \div 1.5$

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

STEMUP.CO.UK

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]

Q13.

(centre of the) Earth [not ground]
gravity
newtons (allow N)

each for 1 mark

[3]

Q14.

(a) WD = force × distance **or** 6 × 2

gains 1 mark

but 12 *gains 2 marks*
units J/joules [credit Nn]

for 1 mark

3

(b) 0.6 (i.e. using the **recalled** 10N/kg)

gains 1 mark

but evidence of force = mass × acceleration
or of correct substitution e.g. 6/9.8

gains 2 marks

but 0.61 (2...)

gains 3 marks

3

STEMUP.CO.UK

(c) *any reference to*
initial acceleration due to gravity
(force due to) friction/air resistance
each for 1 mark

ideas that
this increases as speed increases
forces eventually balance
each for 1 further mark

9

[9]

Q15.

(a) **evidence of* acceleration = $\frac{\text{change in speed}}{\text{time}}$ or $\frac{0.6}{3}$
gains 1 mark

but 0.2
gains 2 marks

units m/s^2
for 1 mark

3

(b) (i) 2000 **or** 1960
for 1 mark

1

(ii) *evidence of* power = $\frac{\text{work done}}{\text{time taken}}$ **or** weight × speed (*credit figures*)/ $\frac{25}{0.6}$

(iii) $\frac{25}{0.6}$
gains 1 mark

but 1200/1176 **or** *figure consistent with (b)(i)*
gains 2 marks

2

(c) *evidence of* force = mass × acceleration **or** 200 × 0.3
gains 1 mark

but 60
gains 2 marks

but 60 + weight of girder (2060/2020*) *(or figure consistent with (b)(i))*
gains 3 marks

3

[9]

Q16.

STEMUP.CO.UK

(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]

Q17.

(a) D

for 1 mark

1

(b) wear it away **or** make it warmer

for 1 mark do not accept 'stops it'

1

[2]

Q18.

(a) *evidence of* $\frac{\text{change in speed}}{\text{time taken}}$ *or* $\frac{3}{12}$

gains 1 mark

but 0.25 **or** ¼

gains 2 marks

2

(b) *evidence of* $\frac{\text{work done}}{\text{time taken}}$ *or* $\frac{2400}{12}$

gains 1 mark

STEMUP.CO.UK

but 200

gains 2 marks

2

(c) *idea that*

second car has a bigger mass
(allow bigger weight/heavier)

gains 1 mark

but
second car has 1.5 times bigger mass
or
second car has mass of 1200 kg

gains 2 marks

2

(d) friction/resistance increases with speed

gains 1 marks

but
friction with/resistance of <u>air</u> increases with speed

gains 2 marks

- increase in speed because driving force greater than friction
- steady speed when friction = driving force

or
increases in speed until friction = driving force

each for 1 further mark to maximum of 3

3

[9]

Q19.

(a) work done = force × distance **or** 250 × 5 **NB** *if formula given must be correct*

gains 1 mark

but

1250

gains 2 marks

[In this and similar examples, a correct answer only gets full marks.

From an incorrect formula, do not allow marks for 'error carried forward'

2

(b)
- (mainly) (transferred as) it is kinetic / movement <u>energy</u> (not 'mechanical')
- (some) lost / wasted / transferred as heat / sound

[Answers must refer to 'energy'. Do not allow 'it drives the bike']

STEMUP.CO.UK

or

used to overcome friction / air resistance

each for 1 mark

2

[4]

Q20.

(a) [NB e.c.f <u>not</u> allowed from incorrect formula]
work done = force × distance or 250 × 5

gains 1 mark

but
1250

gains 2 marks

2

(b) • (mainly) transferred as kinetic / movement energy
[<u>not</u> makes bike move]

• (some) lost / wasted / transferred as heat / sound
or
used to overcome friction / air resistance

each • for 1 mark

2

[4]

Q21.

(a) force distance (*either way round*)
energy

for 1 mark each

3

(b) joules

for 1 mark

1

[4]

STEMUP.CO.UK