AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.1.1.2 CHANGES IN ENERGY (PACK 2)

SCORE	PERCENTAGE
/130	%

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Q1.

(a) $P = \frac{120\,000}{8.0}$ **1**

P = 15 000 (W) **1**

*an answer of 15 000 (W) scores **2** marks*

(b) energy is transferred in heating the surroundings **1**

friction causes energy to be transferred in non-useful ways **1**

(c) the switches are in parallel **1**

(so) closing either switch completes the circuit **1**

(d) gravitational potential energy = mass × gravitational field strength × height
allow $E_p = m\ g\ h$ **1**

(e) $E_p = 280 \times 9.8 \times 14$ **1**

$E_p = 38\,416$ (J) **1**

$E_p = 38\,000$ (J)
*an answer that rounds to 38 000 scores **2** marks* **1**

*an answer of 38 000 scores **3** marks*

[10]

Q2.

(a) $1.2 = \frac{m}{2.3 \times 10^4}$ **1**

$m = 1.2 \times 2.3 \times 10^4$ **1**

m = 27 600 (kg)
allow an answer of 28 000 (kg) or 2.8×10^4 (kg)

or

$m = 2.76 \times 10^4$ (kg) **1**

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*an answer of 27 600 (kg) scores **3** marks*

(b) mass of air passing the turbine blades is halved which decreases kinetic energy by a factor of two

1

(wind speed is halved) decreasing kinetic energy by a factor of four

1

so kinetic energy decreases by a factor of eight

1

allow power output for kinetic energy throughout

(c) $388\,000 = 0.5 \times 13\,800 \times v^2$

this mark may be awarded if P is incorrectly / not converted

1

$$v^2 = \frac{(2 \times 388\,000)}{13\,800}$$

this mark may be awarded if P is incorrectly / not converted

or

$$v^2 = \frac{388\,000}{(0.5 \times 13\,800)}$$

or

$v^2 = 56.2$

1

$v = 7.50$ (m/s)

an answer that rounds to 7.50 (m/s) only

1

[9]

Q3.

(a) uniform acceleration

allow constant / steady acceleration
allow velocity / speed increasing at a constant rate
ignore reference to direction
*acceleration scores **1** mark*
or
*velocity / speed is increasing scores **1** mark*
*do **not** accept acceleration increases*

2

(b) up(wards)

1

(c) a group of objects that interact

1

(d) velocity just after bounce is less than just before bounce

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allow velocity is less / decreases

velocity decreases to zero − on its own scores zero

or

the height at the top of the bounce is less than the height from which it was dropped

1

so the ball has lost energy

1

correct reference to (loss of) ke or (reduced) gpe

1

total energy of ball and Earth / ground is constant

allow 'a system' for ball and Earth

allow energy is conserved

1

[8]

Q4.

(a) kinetic energy = 0.5 × mass × speed^2

allow E_k = 1/2 mv^2

1

(b) $E_k = 0.5 \times 0.058 \times 5^2$

1

E_k = 0.725 (J)

*an answer of 0.725 (J) scores **2** marks*

1

(c) 0.725 (J)

allow ecf from (b)

allow the same amount of E_k as at A

1

(d) gravitational potential energy = mass × gravitational field strength × height

allow Ep = mgh

1

(e) $0.38 = 0.058 \times 9.8 \times h$

1

$$h = \frac{0.38}{(0.058 \times 9.8)}$$

1

h = 0.67 (m)

*an answer that rounds to 0.67 scores **3** marks*

1

[8]

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Q5.

(a) any **two** from:

- bungee rope may snap
- rope may extend too much
- student may land in the river

2

(b) gravitational potential

correct order only

1

kinetic

1

elastic potential

1

(c) ½ × 40 × 35^2

1

24 500 (J)

accept 25 000 (J) (2 significant figures)

1

*allow 24 500 (J) with no working shown for **2** marks*

[7]

Q6.

(a) g.p.e. = mass × gravitational field strength × height

accept $E_p = mgh$

1

(b) $E_p = 50 \times 9.8 \times 20$

1

9800 (J)

*allow 9800 (J) with no working shown for **2** marks*
answer may also be correctly calculated using W = Fs
*ie allow W = 490 × 20 for **1** mark*
*or answer of 9800 (J) using this method for **2** marks*

1

(c) 7840 (J)

allow ecf from '11.2'

1

(d) $7840 = ½ \times 50 \times v^2$

1

$$v = \sqrt{\frac{7840}{1/2 \times 50}}$$

allow $v^2 = \frac{7840}{(1/2 \times 50)}$ *for this point*

1

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17.7(0875) (m / s)

1

18 (m / s)

*allow ecf from '11.3' correctly calculated for **3** marks*
*allow 18 (m / s) with no working for **2** marks*
answer may also be correctly calculated using $v^2 - u^2 = 2as$

1

(e) extension = 35 (m) and conversion of 24.5 kJ to 24500 J

1

$24\,500 = ½ \times k \times 35^2$

1

40

1

*allow 40 with no working shown for **3** marks*
*an answer of '16.2' gains **2** marks*

[11]

Q7.

(a) It will have a constant speed.

1

(b) distance travelled = speed × time

1

(c) $a = \frac{18 - 9}{6}$

1

a = 1.5

*allow 1.5 with no working shown for **2** marks*

1

(d) resultant force = mass × acceleration

1

(e) F = (1120+80) × 1.5

1

F = 1800 (N)

*allow 1800 with no working shown for **2** marks*

1

*accept their 10.3 × 1200 correctly calculated for **2** marks*

(f) $18^2 - 9^2 = 2 \times 1.5 \times s$

1

$s = 18^2 - 9^2 / 2 \times 1.5$

1

s = 81 (m)

1

*allow 81 (m) with no working shown for **3** marks*

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*accept answer using their 10.3 (if not 1.5) correctly calculated for **3** marks*

(g) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that include references to the numerical factor.

Level 1 (1–2 marks):
Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:
No relevant content.

Indicative content
- doubling speed increase the kinetic energy
- kinetic energy increases by a factor of 4
- work done (by brakes) to stop the car increases
- work done increases by a factor of 4
- work done is force × distance and braking force is constant
- so if work done increases by 4 then the braking distance must increase by 4

4

[14]

Q8.

(a) gravity

accept weight for gravity
air resistance is insufficient

1

(b) (i) 800

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

$$P = \frac{2240}{2.8}$$

provided no subsequent step

2

(ii) 2240 J

1

(c) (i) (vertical) height

accept (height of) stairs

1

(ii) a fast / short time (for a lighter student) may give the greatest power

accept time is a factor

or
a slow / long time (for a heavy student) may give the least power

fitness is insufficient

1

[6]

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Q9.

(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 × 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

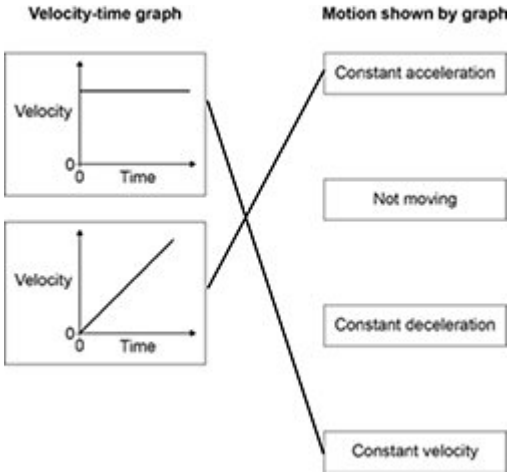
accept m/s/s

1

[6]

Q10.

(a)



*if more than one line is drawn from a graph then all those lines are wrong allow **1** mark for 1 correct line*

2

(b) speed

1

(c) (i) 2.25

*allow **1** mark for correct substitution i.e.*

$a = \frac{9 - 0}{4}$ or $a = \frac{9}{4}$

provided no subsequent step

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2

(ii) the air resistance increases

1

(d) 2000 J

1

mass is half
or
kinetic energy depends on mass
*do **not** accept weight for mass*

1

[8]

Q11.

(a) (i) decreases (to zero)

1

resultant force acts in opposite direction to motion
accept air resistance and weight for resultant force
accept resultant force acts downwards
*do **not** accept air resistance increases*

1

(ii) velocity includes direction
or
velocity is a vector (quantity)

1

(b) (i) 3.6
allow 1 mark for correct substitution i.e.
½ × 0.05 × 12^2 provided no subsequent step

2

(ii) 3.6 **or** their (i)

1

(iii) 7.2
or
their (ii) ÷ 0.5 correctly calculated
*allow **1** mark for correct substitution i.e.*
3.6 or their (ii) = 0.05 × 10 × h

2

(iv) **B**

1

(c) range increases up to 45°

1

range decreases from 45°
the range is a maximum at 45° gains both marks
for any two angles that add up
to 90° the range is the same gains both marks
*the range increases then decreases gains **1** mark*

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1

[11]

Q12.

(a) (i) kinetic (energy)

allow gravitational potential (energy) / gpe

movement is insufficient

1

(ii) dissipates into the surroundings

allow warms up the surroundings / air / motor

accept lost to the surroundings

accept lost as heat

ignore reference to sound

it is lost is insufficient

1

(b) energy (required) increases with load

accept positive correlation

*do **not** accept (directly) proportional*

1

further amplification eg increases slowly at first (or up to 4 / 5 N), then increases rapidly

simply quoting figures is insufficient

an answer that only describes the shape of the line gains no marks

1

(c) (i) $E = P \times t$

2880

*accept £28.80 for all **3** marks*

*an answer £2880 gains **2** marks*

*allow **1** mark for obtaining 48 h **or** converting to kW*

*allow **2** marks for correct substitution*

ie 4 × 48 × 15

note: this substitution may be shown as two steps

*an answer 2 880 000 gains **2** marks*

*an answer £4.80 / 480 gains **2** marks*

*an answer of 192 (ie calculation of energy without subsequent calculation of cost) gains **1** mark)*

3

(ii) any sensible suggestion eg

conserves fossil fuels

less (fossil) fuels burned

less pollutant gas (produced)

accept a named pollutant gas

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less greenhouse gas (produced)

saves energy is insufficient

1

[8]

Q13.

(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]

Q14.

(a) 1 080 000

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

ie ½ × 15 000 × 12 × 12

2

(b) any **one** from:

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- KE (of wind) more than doubles
- mass of air (hitting blades) more than doubles
- area swept out by blades more than doubles
  *do **not** accept blades are larger / have a bigger area*
- area swept out by blades increases × 4

1

[3]

Q15.

(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]

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