Mark Scheme Energy Past Paper Questions

Jan 2002 to Jan 2009

Q5 Jan 2002

5(a) decreases for the first four seconds ✓
zero for the remaining six seconds ✓

(b) $E_k = \frac{1}{2} \times 1.4 \times 10^3 \times 16^2 \ ✓$
    $= 1.8 \times 10^5 \text{ J} \ ✓$
    (accept $v = 15 \text{ m s}^{-1}$ from misleading graph and $E_k = 1.6 \times 10^5 \text{ J}$)

(c) (use of $P = Fv$ gives) $20 \times 10^3 = F \times 30 \ ✓$
    $F = 670 \text{ N} \ ✓$

Q6 Jan 2002

6(a) loss of potential energy = $m \times 9.81 \times 6.0 \ ✓$
    gain in kinetic energy = loss of potential energy ✓
    $\frac{1}{2}mv^2 = 58.9 \text{ m}$ gives $v = 10.8 \text{ (m s}^{-1}) \ (\approx 11 \text{ m s}^{-1}) \ ✓$

(b) loses potential energy (as it moves to B) ✓
    gains kinetic energy (as it moves to B) ✓
    regains some potential energy at the expense of kinetic energy as it moves from B to C ✓
    some energy lost as heat (due to friction) ✓
7(a)(i) \[ E_p = mg \Delta h \checkmark \]
\[ = 5.8 \times 10^{-2} \times 9.8(1) \times 1.5 = 0.85 \text{ J} \checkmark \]

(ii) \[ 0.85 \text{ J} \checkmark \]
(allow C.E. for value of \( E_p \) from (i))

(iii) (use of \( E_k = \frac{1}{2}mv^2 \) gives) \[ 0.85 = 0.5 \times 5.8 \times 10^{-2} \times v^2 \checkmark \]
(allow C.E. for answer from (ii))
\[ (v^2 = 29.3) \]
\[ v = 5.4 \text{ m s}^{-1} \checkmark \]

(iv) (use of \( p = mv \) gives) \[ p = 5.8 \times 10^{-2} \times 5.4 \checkmark \]
(allow C.E. for value of \( v \) from (iii))
\[ = 0.31 \text{ N s} \checkmark \]

(b) \[ \text{use of } F = \frac{\Delta(mv)}{\Delta t} \text{ gives} \]
\[ F = \frac{0.31}{0.010} \checkmark \]
(allow C.E. for value of \( p \) from (iv))
\[ = 31 \text{ N} \checkmark \]
\[ \text{[or } a = \frac{5.4}{0.010} = 540 \text{ (m s}^{-2}) \checkmark \]
\[ F = 5.8 \times 10^{-2} \times 540 = 31 \text{ N } \checkmark \]

(c) egg effectively stopped in a longer distance \( \checkmark \)
hence greater time and therefore less force on egg \( \checkmark \)
[or takes longer to stop]
hence force is smaller as \[ F = \frac{\Delta(mv)}{t} \]
[or acceleration reduced as it takes longer to stop
thus force will be smaller]

[or some energy is absorbed by container
less absorbed by egg] \( \checkmark \)
(a)(i) (use of \( E_p = mgh \) gives) \[ E_p = 70 \times 9.81 \times 150 \checkmark \]
\[ = 1.0(3) \times 10^5 \text{ J} \checkmark \]

(ii) (use of \( E_k = \frac{1}{2}mv^2 \) gives) \[ E_k = \frac{1}{2} \times 70 \times 45^2 \checkmark \]
\[ = 7.1 \times 10^4 \text{ J} \checkmark \] \[(7.09 \times 10^4 \text{ J}) \] (4)

(b)(i) work done \((= 1.03 \times 10^5 - 7.09 \times 10^4) = 3.2(1) \times 10^4 \text{ J} \checkmark \)
(allow C.E. for values of \( E_p \) and \( E_k \) from (a))

(ii) (use of work done = \( Fs \) gives) \[ 3.21 \times 10^4 = F \times 150 \checkmark \]
(allow C.E. for value of work done from (i))
\[ F = 210 \text{ N} \checkmark \] \[ (213 \text{ N}) \] (7)

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<thead>
<tr>
<th>Question 2</th>
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<tbody>
<tr>
<td>(a) (i) (gravitational) potential energy ( \checkmark ) to kinetic energy ( \checkmark )</td>
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<tr>
<td>(ii) both trolley and mass have kinetic energy ( \checkmark ) mention of thermal energy (due to friction) ( \checkmark )</td>
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<tr>
<td>(b) masses of trolley and falling mass ( \checkmark ) distance mass falls (or trolley moves) and time taken to fall (or speed) ( \checkmark )</td>
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<tr>
<td>(c) calculate loss of gravitational pot. energy of falling mass (mgh) ( \checkmark ) calculate speed of trolley (as mass hits floor), with details of speed calculation ( \checkmark ) calculate kinetic energy of trolley ( \checkmark ) and mass ( \checkmark ) compare (loss of) potential energy with (gain of) kinetic energy ( \checkmark )</td>
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<td>Total</td>
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<td>(b) (use of ( \frac{1}{2}mv^2 = mgh ) gives) ( \frac{1}{2}v_b^2 = 9.81 \times 1.5 \checkmark ) [ v_b = 5.4(2) \text{ m s}^{-1} \checkmark ] [(\text{assumption}) \text{ energy converted to thermal energy is negligible} \checkmark ]</td>
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<td>(c) component of weight down the slope causes acceleration ( \checkmark ) this component decreases as skateboard moves further down the slope ( \checkmark ) air resistance/friction increases (with speed) ( \checkmark )</td>
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<tr>
<td>(d) (i) distance ((= 0.42 \times 5.4) = 2.3 \text{ m} \checkmark ) [(2.27 \text{ m}) ] (allow C.E. for value of ( v_b ) from (b))</td>
</tr>
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</table>
| (ii) \[ v_v = 9.8 \times 0.42 \checkmark \]
\[ = 4.1(1) \text{ m s}^{-1} \checkmark \] | 5 |
| (iii) \[ v^2 = 4.1^2 + 5.4^2 \checkmark \] \[ v = 6.8 \text{ m s}^{-1} \checkmark \] \[(6.78 \text{ m s}^{-1}) \] (allow C.E. for value of \( v_b \) from (b)) | |
| Total | 12 |