

# Work Done & Power Past Paper Questions

## Jan 2002 to Jan 2009

- 5(a) decreases for the first four seconds ✓  
zero for the remaining six seconds ✓ (2)

### Q5 Jan 2002

- (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  $E_k = 1.6 \times 10^5 \text{ J}$ ) (2)

- (c) (use of  $P = Fv$  gives)  $20 \times 10^3 = F \times 30$  ✓  
 $F = 670 \text{ N}$  ✓ (2)  
(6)

- 5(a) (use of  $F = ma$  gives)  $F = 1.3 \times 10^3 \times 2.5$  ✓  
 $= 3250 \text{ N}$  ✓ ( $3.25 \times 10^3$ ) (2)

- (b)(i) driving force =  $3250 + 410 = 3660 \text{ N}$  ✓  
(allow C.E. from (a))

### Q5 Jun 2002

- (ii) (use of  $P = Fv$  gives)  $P = 3660 \times 2.2$  ✓  
(allow C.E. from (i))  
 $= 8100 \text{ W}$  ✓ ( $8.1 \times 10^3$ ) (3)

- (c) (component of) car's weight opposes motion  
[or overcomes gravity  
or more work is done as car gains potential energy] ✓ (1)  
(6)

- 7(a) mark out (equal) distances along height being raised ✓  
measure time taken to travel each of these distances ✓  
times should be equal ✓ (2)  
[or use a position sensor attached to a data logger  
measure distance or speeds at regular intervals  
increase in distance or speeds should be constant] max(2)

### Q7 Jan 2003

- (b) find work done by motor from gain in potential energy of metal block ✓  
divide work done by time to find power ✓  
measurements: mass of block, height block has risen and time taken ✓  
[or power =  $Fv$   
force is weight of block  
velocity is velocity of block  
same measurements as above] max(2)  
(4)

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(a)(i) (use of  $E_p = mgh$  gives)  $E_p = 70 \times 9.81 \times 150 \checkmark$   
 $= 1.0(3) \times 10^5 \text{ J} \checkmark$

**Q4 Jun 2004**

(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  $\times 10^4$  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 N) (3)  
(7)

**Question 3**

- (a) resultant force on crate is zero  $\checkmark$   
 forces must have equal magnitudes or size  $\checkmark$   
 (but) act in opposite directions  $\checkmark$   
 correct statement of 1<sup>st</sup> or 2<sup>nd</sup> law  $\checkmark$

**Q3 Jan 2005**

max(3)

(b)(i) work done =  $F \times d = 640 \times 9.81 \times 8.0 \checkmark$   
 $= 5.0(2) \times 10^4 \text{ J} \checkmark$

(ii) (use of  $P = \frac{W}{t}$  gives)  $P = \frac{5.02 \times 10^4}{4.5} = 1.1(2) \times 10^4 \text{ W} \checkmark$   
 (allow C.E. for value of work done from (i)) (3)  
(6)

Question 3		Q3 Jan 2007	
(a)	(i)	(use of $F_H = F \cos \theta$ gives) resultant force = $2 \times 6500 \cos 35$ resultant force = 11 000 N (10 649) (1 out of 2 if only one component given)	$\checkmark\checkmark$
	(ii)	(use of work = force $\times$ distance gives) work = $11\ 000 \times 1.5 \times 60$ work = 990 000 J (958 408) (if use 10 649 then 960 000 J)	$\checkmark\checkmark$
(b)		there is an opposing force <b>or</b> mention of friction/drag work is done on this force <b>or</b> overall resultant force is zero	$\checkmark\checkmark$
(c)		initially accelerates as horizontal component increases (so) forward force now larger than drag <b>or</b> resultant force no longer zero <b>or</b> now a resultant forward force eventually reaches new higher constant speed	$\checkmark\checkmark\checkmark$
			<b>Total</b>
			<b>9</b>

Question 5		
<p>(i) find students weight (<b>or</b> mass) ✓ measure (vertical) height (of stairs) ✓ time (how long it takes student to run up stairs) ✓</p> <p>(ii) using <math>E_p = mgh</math> ✓ link measurements to quantities used to calculate <math>E_p</math> ✓ divide gain in <math>E_p</math> (<b>or</b> work) by time to get power ✓</p> <p>(iii) not all work done goes to <math>E_p</math> ✓ ignoring gain in <math>E_k</math> ✓ <b>or</b> ignoring movement <b>or</b> ignoring friction <b>or</b> athlete gets hot <b>or</b> body not 100% efficient</p>	<p><b>Q5 Jun 2007</b></p>	<p><b>8</b></p>
	<p><b>Total</b></p>	<p><b>8</b></p>

Question 2	<b>Q2 Jan 2009</b>	
<p>(a) (i)</p> <p>(ii)</p>	<p>vector has direction <b>and</b> a scalar does not ✓</p> <p>scalar examples; any two e.g. speed, mass, energy, time, power</p> <p>vector examples; any two e.g. displacement, velocity, acceleration, force or weight</p> <p>✓✓✓ for 4 correct, ✓✓ for 3 correct, ✓ for 2 correct</p>	<p><b>4</b></p>
<p>(b) (i)</p> <p>(ii)</p>	<p>horizontal component (= <math>2.8 \cos 35</math>) = 2.3 (kN) (2293.6) ✓</p> <p>vertical component (= <math>2.8 \sin 35</math>) = 1.6 (kN) (1606.0) ✓</p> <p>power = force × velocity <b>or</b> <math>2.3 \text{ kN} \times 8.3 \text{ m s}^{-1}</math> ✓ (ecf from 2 (b)(i)) = <math>1.9 \times 10^4</math> (19037 or 19100) ✓ ecf <b>W</b> (or <math>\text{J s}^{-1}</math>) ✓ (or 19 W (or <math>\text{kJ s}^{-1}</math>))</p>	<p><b>5</b></p>
<p>(c)</p>	<p>(area of cross-section of cable =) <math>\pi \times (\frac{1}{2} 0.014)^2</math> ✓ = <math>1.5(4) \times 10^{-4} (\text{m}^2)</math> ✓</p> <p>stress (= <math>F/A</math>) = <math>\frac{2800 \text{ N}}{1.54 \times 10^{-4} \text{ m}^2}</math> (allow ecf here if attempt to calculate area) ✓</p> <p>= <math>1.8(2) \times 10^7</math> ✓ ecf</p> <p><b>Pa</b> (or <math>\text{N m}^{-2}</math>) ✓</p>	<p><b>5</b></p>
	<p><b>Total</b></p>	<p><b>14</b></p>