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) $E_k = ½ \times 1.4 \times 10^3 \times 16^2$ ✓
$= 1.8 \times 10^5$ J ✓
(accept $v = 15$ m s^{-1} from misleading graph and $E_k = 1.6 \times 10^5$ J) (*2*)

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

5(a) (use of $F = ma$ gives) $F = 1.3 \times 10^3 \times 2.5$ ✓
$= 3250$ N ✓(3.25×10^3) (*2*)

(b)(i) driving force = 3250 + 410 = 3660 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))
$= 8100$ W ✓ (8.1×10^3) (*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 ✓
[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*)

Q4 Jun 2004

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

(ii) (use of $E_k = ½mv^2$ gives) $E_k = ½ \times 70 \times 45^2$ ✓
$= 7.1 \times 10^4$ J ✓ (7.09×10^4 J) (*4*)

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

(ii) (use of *work done* = *Fs* gives) $3.21 \times 10^4 = F \times 150$ ✓
(allow C.E. for value of *work done* from (i))
$F = 210$ N ✓ (213 N) (*3*)
(*7*)

Question 3

Q3 Jan 2005

(a) resultant force on crate is zero ✓
forces must have equal magnitudes or size ✓
(but) act in opposite directions ✓
correct statement of 1st or 2nd law ✓ max(*3*)

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

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

Q3 Jan 2007

Question 3				
(a)	(i)	(use of $F_H = F \cos \theta$ gives) resultant force = 2 × 6500 cos 35 resultant force = 11 000 N (10 649) (1 out of 2 if only one component given)	✓✓	**4**
	(ii)	(use of work = force × distance gives) work = 11 000 × 1.5 × 60 work = 990 000 J (958 408) (if use 10 649 then 960 000 J)	✓✓	
(b)		there is an opposing force **or** mention of friction/drag work is done on this force **or** overall resultant force is zero	✓✓	**2**
(c)		initially accelerates as horizontal component increases (so) forward force now larger than drag **or** resultant force no longer zero **or** now a resultant forward force eventually reaches new higher constant speed	✓✓✓	**max 3**
			Total	**9**

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

Question 2	**Q2 Jan 2009**	
(a) (i)	vector has direction **and** a scalar does not ✓	
(ii)	scalar examples; any two e.g. speed, mass, energy, time, power vector examples; any two e.g. displacement, velocity, acceleration, force or weight ✓✓✓ for 4 correct, ✓✓ for 3 correct, ✓ for 2 correct	4
(b) (i)	horizontal component (= 2.8 cos 35) = 2.3 (kN) (2293.6) ✓ vertical component (= 2.8 sin 35) = 1.6 (kN) (1606.0) ✓	
(ii)	power = force × velocity **or** 2.3 kN × 8.3 m s^{-1} ✓ (ecf from 2 (b) (i)) = 1.9 × 10^{4} (19037 or 19100) ✓ ecf **W** (or J s^{-1}) ✓ (or 19 W (or kJ s^{-1}))	5
(c)	(area of cross-section of cable =) π × (½ 0.014)^{2} ✓ = 1.5(4) × 10^{-4} (m^{2}) ✓ stress (= F/A) = $\frac{2800\,\text{N}}{1.54\times10^{-4}\,\text{m}^2}$ (allow ecf here if attempt to calculate area) ✓ = 1.8(2) × 10^{7} ✓ ecf **Pa** (or N m^{-2}) ✓	5
	Total	**14**