Physics 12

August 2005 Provincial Examination

ANSWER KEY / SCORING GUIDE

CURRICULUM:

	Organizers	Sub-Organizers
1.	Vector Kinematics in Two Dimensions	A, B
	and	
	Dynamics *and* Vector Dynamics	C, D
2.	Work, Energy and Power	E
	and	
	Momentum	F, G
3.	Equilibrium	H
4.	Circular Motion	I
	and	
	Gravitation	J
5.	Electrostatics	K, L
6.	Electric Circuits	M, N
7.	Electromagnetism	O, P

PART A: Multiple Choice (each question worth TWO marks)

Q	K	C	S	CO	PLO	Q	K	C	S	CO	PLO
1.	A	K	2	1	B6	19.	A	K	2	4	J2, 9
2.	B	U	2	1	B2	20.	A	U	2	4	J2, 3
3.	D	U	2	1	B8	21.	D	U	2	4	J2, 3; A10
4.	C	K	2	1	C7	22.	C	U	2	4	J8
5.	B	U	2	1	D5	23.	A	H	2	4	J6, 7; E7
6.	D	U	2	1	D6	24.	D	K	2	5	K6
7.	B	U	2	2	E8	25.	D	U	2	5	K3
8.	B	U	2	2	E8	26.	C	U	2	5	L8
9.	A	U	2	2	F4	27.	A	U	2	6	M11
10.	B	U	2	2	F4	28.	A	U	2	6	M7, 11
11.	C	U	2	2	G3	29.	A	U	2	6	N3
12.	C	K	2	3	H4	30.	B	K	2	7	P12
13.	B	U	2	3	H3	31.	A	U	2	7	O2
14.	C	U	2	3	H11	32.	A	U	2	7	O3, 8
15.	C	U	2	3	H8, 5	33.	C	U	2	7	P1
16.	A	U	2	4	I4	34.	A	U	2	7	P6; O3
17.	A	U	2	4	I4	35.	A	U	2	7	P5
18.	D	U	2	4	I5; D4						

Multiple Choice = 70 marks

PART B: Written Response

Q	B	C	S	CO	PLO
1.	1	U	5	1	B8, 7
2.	2	U	5	3	H11, 8
3.	3	H	6	5	L6; E7
4.	4	U	5	7	O5
5.	5	H	5	1	C7; A10
6.	6	H	4	6	M11, 9

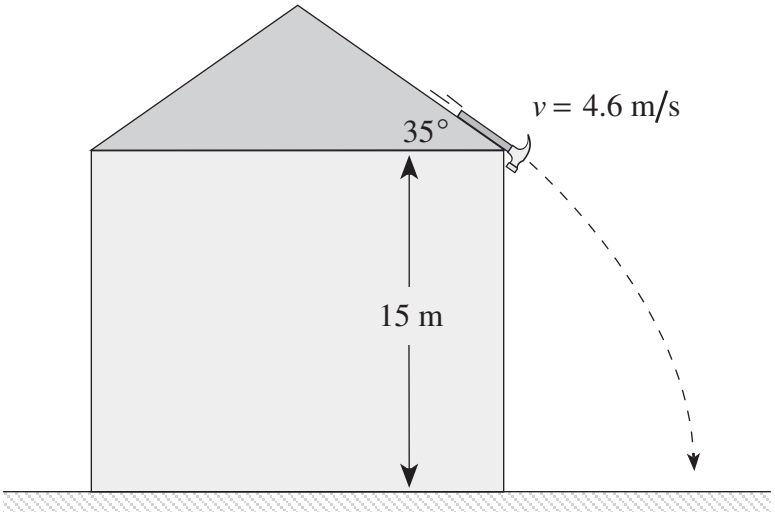
Written Response = 30 marks

Multiple Choice = 70 (35 questions)
Written Response = 30 (6 questions)
EXAMINATION TOTAL = 100 marks

LEGEND:

Q = Question Number
B = Score Box Number
C = Cognitive Level
CO = Curriculum Organizer
K = Keyed Response
S = Score
PLO = Prescribed Learning Outcome

1. A hammer slides down a roof sloped at $35°$ reaching a speed of $4.6\ \text{m/s}$ before falling off.



How much time does it take to fall the 15 m to the ground? **(5 marks)**

$$v_y^{\,2} = v_{1y}^{\,2} + 2ad_y$$

$$v_y = \sqrt{(4.6 \cdot \sin 35)^2 + 2 \times -9.8 \times -15}$$

$$v_y = -17.3\ \text{m/s}$$

← **3 marks**

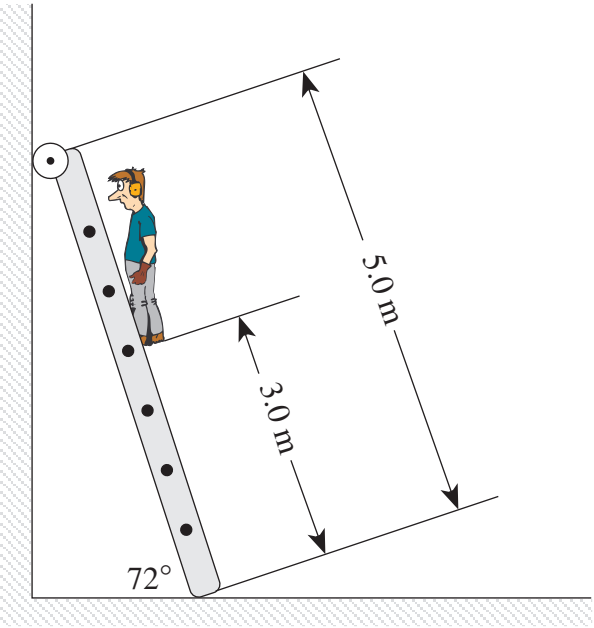
$$t = \frac{\Delta v_y}{g}$$

$$= \frac{-17.3 - (-4.6 \sin 35)}{-9.8}$$

$$= 1.5\ \text{s}$$

← **2 marks**

2. A 65 kg man is 3.0 m up a 5.0 m, 16 kg ladder leaning against a smooth wall at an angle of 72° as shown below.



What minimum force of friction between the ladder and the floor is required to keep the ladder from sliding? **(5 marks)**

$$\Sigma\tau = 0$$

$$\tau_c = \tau_{cc} \qquad \leftarrow \textbf{1 mark}$$

$$F_w \times \sin 72° \times 5 = 65 \times 9.8 \times \sin 18° \times 3 + 16 \times 9.8 \times \sin 18° \times 2.5 \qquad \leftarrow \textbf{2 marks}$$

$$F_w \times 4.755 = 590.53 + 121.13 \qquad \leftarrow \textbf{1 mark}$$

$$F_f = F_w = \frac{711.66}{4.755}$$

$$\therefore F_f = 150 \text{ N} \qquad \leftarrow \textbf{1 mark}$$

3. Alpha particles with a mass of 6.6×10^{-27} kg and a charge of 3.2×10^{-19} C are fired towards each other from a great distance.

a) If they each have a speed of 2.5×10^{6} m/s to start with, what will be their minimum separation distance? **(4 marks)**

$$\Delta E_p = -\Delta E_k \qquad \leftarrow \textbf{1 mark}$$

$$\Delta E_k = 0 - 2\left(\frac{1}{2}mv^2\right)$$

$$= -2\cdot\frac{1}{2}\cdot 6.6\times10^{-27}\text{ kg}\cdot\left(2.5\times10^{6}\text{ m/s}\right)^2$$

$$= -4.13\times10^{-14}\text{ J}$$

$$\therefore \Delta E_p = 4.13\times10^{-14}\text{ J} \qquad \leftarrow \textbf{1 mark}$$

$$\frac{kQQ}{r_{\min}} = 4.13\times10^{-14}\text{ J} \qquad \leftarrow \textbf{1 mark}$$

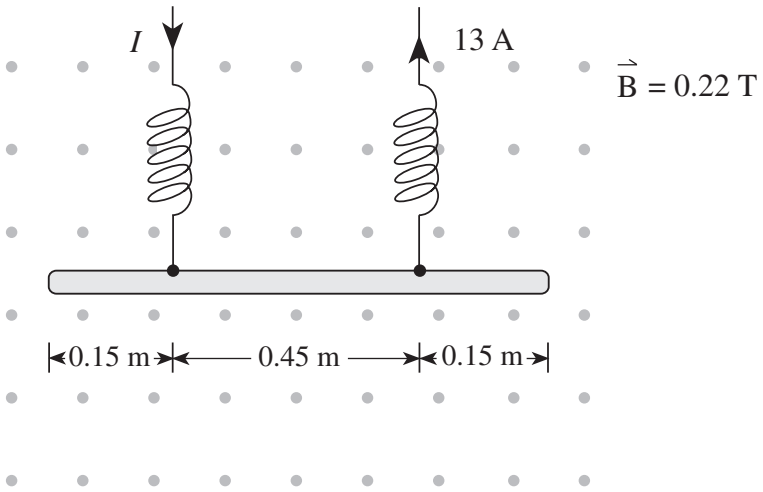
$$r_{\min} = \frac{\left(3.2\times10^{-19}\text{ C}\right)^2\cdot 9.0\times10^{9}\text{ N}\cdot\text{m}^2/\text{C}^2}{4.13\times10^{-14}\text{ J}} \qquad \leftarrow \tfrac{1}{2}\textbf{ mark}$$

$$= 2.2\times10^{-14}\text{ m} \qquad \leftarrow \tfrac{1}{2}\textbf{ mark}$$

b) Using energy principles, explain why the particles do not come any closer than this minimum separation distance. **(2 marks)**

As the charged particles approach each other kinetic energy is transformed into electric potential energy. (1 mark) At the minimum separation distance the electric potential energy is equal to the initial kinetic energy. Additional kinetic energy would have been needed to bring the particles any closer. (1 mark)

4. A 0.75 m metal rod is suspended as shown. A current of 13 A then flows as indicated.



a) Is the tension in the springs increased or decreased? **(1 mark)**

The tension in the springs will be increased. ← 1 mark

b) How much does the tension change? **(4 marks)**

$F = BI\ell$ ← **1 mark**

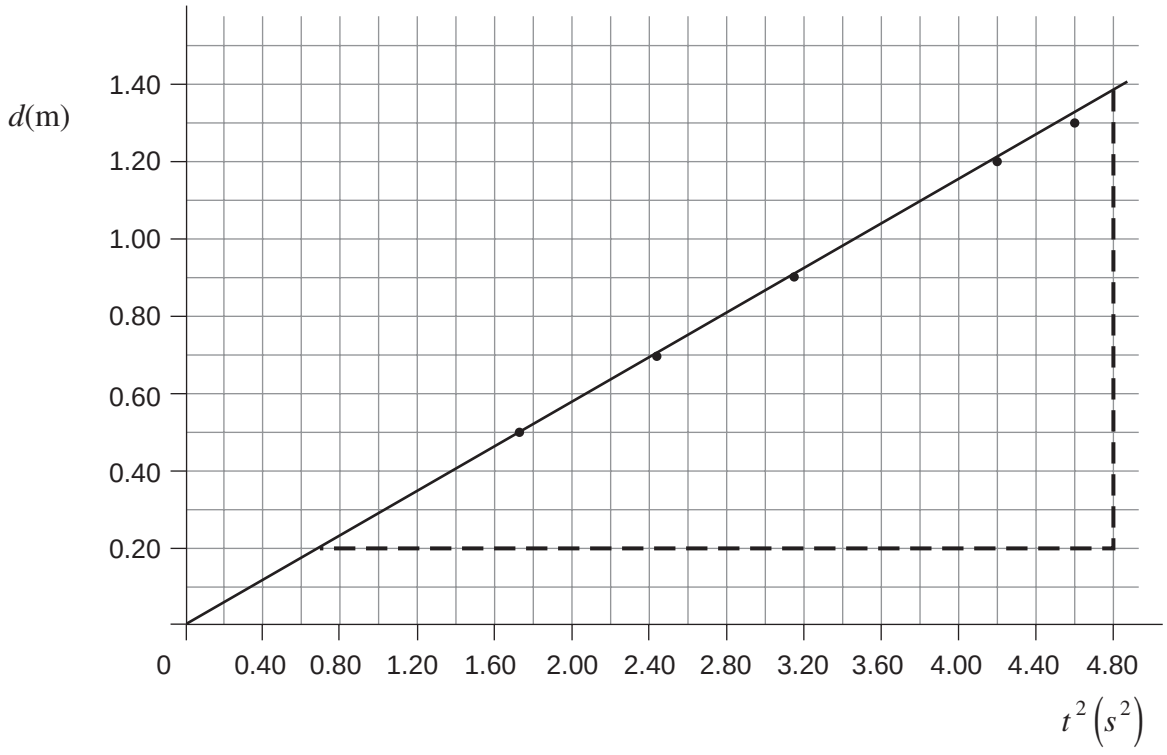
$= 0.22(13)0.45$ ← **2 marks**

$F = 1.3$ N ← **1 mark**

5. An experiment was performed on the surface of an asteroid. A mass was dropped from various heights and the time taken to fall was recorded.

d(m)	t(s)	t^2(s^2)
0	0	**0**
0.50	1.31	**1.72**
0.70	1.56	**2.43**
0.90	1.77	**3.13**
1.20	2.05	**4.20**
1.30	2.15	**4.62**

a) Plot a straight line graph of d vs. t^2. **(2 marks)**



b) From your straight line graph, determine the slope of the line. (Include units.) **(1 mark)**

$$slope = \frac{\Delta d}{\Delta t^2} \approx 0.28 \text{ m/s}^2 \qquad \leftarrow \textbf{1 mark}$$

c) What is the acceleration due to gravity on the surface of this asteroid? **(2 marks)**

$$d = \frac{1}{2} a t^2$$

$$d = \left(0.28 \text{ m/s}^2\right) t^2$$

$$\therefore \frac{1}{2} a = 0.28 \text{ m/s}^2$$

$$a = 0.56 \text{ m/s}^2 \qquad \leftarrow \textbf{2 marks}$$

(Allocate one mark for 0.28 m/s^2 only.)

6. When checked with a voltmeter, an old 6 V lantern battery shows the expected reading of 6.0 V. However, the battery fails to light a low resistance light bulb. Identify the property of the battery that must have changed as it aged.

   Explain why this change to the property results in the bulb no longer lighting. **(4 marks)**

Increased resistance. (1 mark)

The old battery has an increased internal resistance. (1 mark) When combined with the bulb's resistance, the circuit current, $\frac{\mathcal{E}}{R_T}$ will be too low to light the bulb. (2 marks)

END OF KEY