Physics 12

August 2006 — Form A

Provincial Examination — Answer Key

Cognitive Processes

K = Knowledge
U = Understanding
H = Higher Mental Processes

Question Types

35 = Multiple Choice (MC)
6 = Written Response (WR)

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Vector Kinematics in Two Dimensions	A, B	9 %
and Dynamics *and* Vector Dynamics	C, D	9 %
2. Work, Energy and Power	E	6 %
and Momentum	F, G	6 %
3. Equilibrium	H	12 %
4. Circular Motion	I	8 %
and Gravitation	J	8 %
5. Electrostatics	K, L	12 %
6. Electric Circuits	M, N	12 %
7. Electromagnetism	O, P	18 %

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	B	K	2	1	A2	MC
2.	C	U	2	1	B2	MC
3.	A	U	2	1	B8	MC
4.	B	K	2	1	C1	MC
5.	B	U	2	1	D5	MC
6.	B	U	2	1	D6	MC
7.	C	U	2	2	E7	MC
8.	B	U	2	2	E8	MC
9.	B	U	2	2	F4	MC
10.	D	U	2	2	F4	MC
11.	C	U	2	2	G3	MC
12.	D	K	2	3	H4, 8	MC
13.	D	U	2	3	H3	MC
14.	C	U	2	3	H5	MC
15.	A	U	2	3	H5	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
16.	A	K	2	4	I3	MC
17.	C	U	2	4	I4	MC
18.	B	U	2	4	I5	MC
19.	C	U	2	4	J9	MC
20.	A	H	2	4	J10	MC
21.	C	K	2	4	J4	MC
22.	C	U	2	5	K2	MC
23.	B	U	2	5	L5	MC
24.	B	U	2	5	L6	MC
25.	B	U	2	5	L7	MC
26.	C	U	2	6	M6	MC
27.	D	U	2	6	M5, 7	MC
28.	B	U	2	6	M11, 5	MC
29.	C	U	2	6	M9, 2	MC
30.	A	K	2	7	O1	MC
31.	D	U	2	7	O6	MC
32.	C	U	2	7	O5, D3	MC
33.	C	U	2	7	P3	MC
34.	C	U	2	7	P6, 5	MC
35.	A	U	2	7	P11	MC

Physics 12

August 2006

Provincial Examination —Written-Response Key / Scoring Guide

Cognitive Processes

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Question Types

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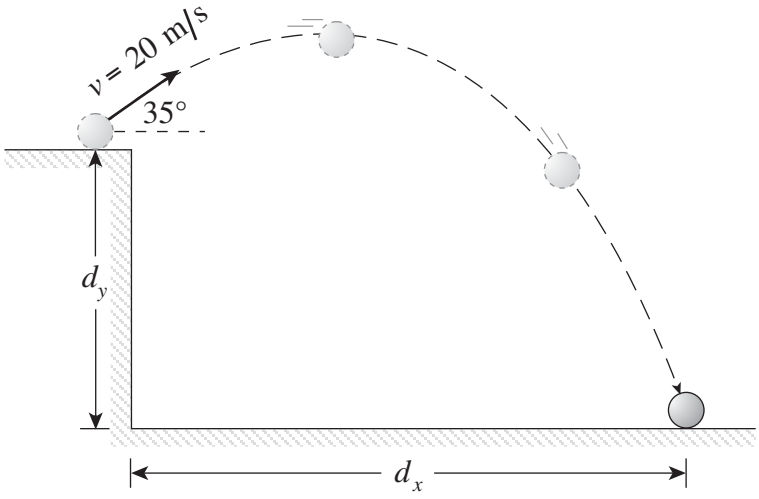
6. Electric Circuits	M, N	12 %
7. Electromagnetism	O, P	18 %

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	–	H	5	1	B8	WR
2.	–	U	5	3	H11	WR
3.	–	H	6	5	L4	WR
4.	–	U	5	7	O6; E7	WR
5.	–	H	5	1	C8	WR
6.	–	H	4	6	M7, 4	WR

1. **(5 marks)**

A projectile is launched from a cliff top at $20\ \text{m/s}$, $35°$ above the horizontal as shown below. The projectile hits the ground 3.7 s after it is launched.



Determine the height of the cliff (d_y) and the range (d_x) of the projectile.

$d_y = (20\sin 35°)3.7 + \frac{1}{2}(-9.8)3.7^2$ ← **2 marks**

$d_y = -25\ \text{m}$

height of cliff = 25 m ← **1 mark**

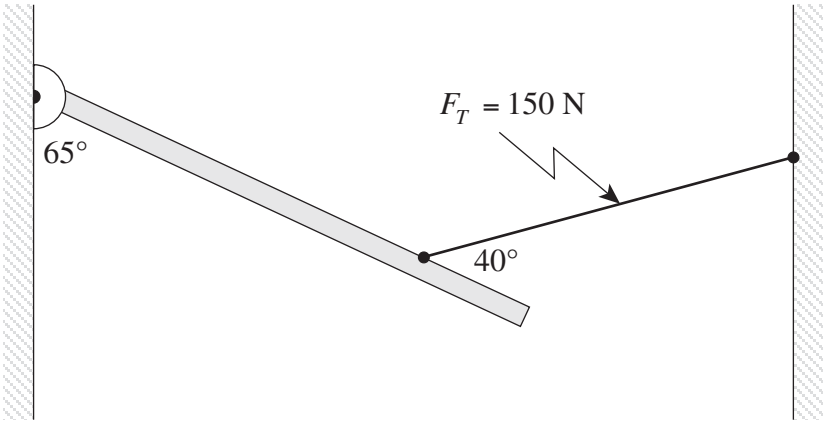
Note to markers: Accept positive or negative answer.

$d_x = (20\cos 35°)3.7$ ← **1 mark**

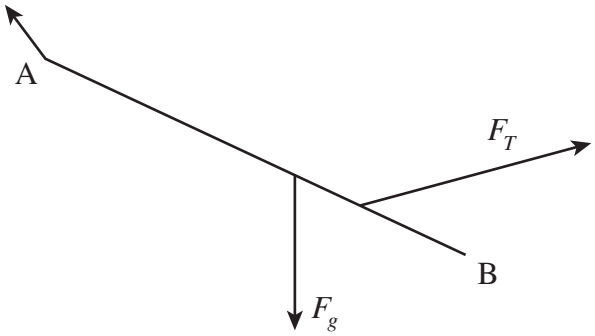
$d_x = 61\ \text{m}$ ← **1 mark**

2. **(5 marks)**

A 4.0 m long steel beam is supported 3.0 m from a hinge by a cable attached as shown.



If the tension in the cable is 150 N what is the mass of the steel beam?



$$\Sigma\tau_A = 0$$

$$\therefore 150\sin 40° \cdot 3.0 = F_g \cdot \sin 65° \cdot 2.0 \qquad \leftarrow \textbf{3 marks}$$

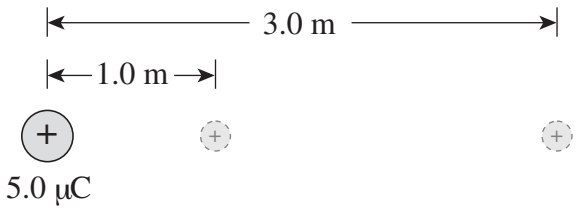
$$\therefore 150\ \text{N} \cdot \sin 40° \cdot 3.0\ \text{m} = m \cdot 9.8\ \text{N/kg} \cdot \sin 65° \cdot 2.0$$

$$\therefore m = \frac{150\ \text{N} \cdot \sin 40° \cdot 3.0\ \text{m}}{9.8\ \text{N/kg} \cdot \sin 65° \cdot 2.0\ \text{m}} \qquad \leftarrow \textbf{1 mark}$$

$$= 16\ \text{kg} \qquad \leftarrow \textbf{1 mark}$$

3. **(6 marks)**

A proton at rest 1.0 m from a fixed $5.0\ \mu C$ charge is released as illustrated.



Calculate the speed of the proton when it is 3.0 m from the fixed charge.

$$E_{p_1} = E_{p_2} + E_{k_2} \qquad \leftarrow \textbf{1 mark}$$

$$\frac{kqQ}{r_1} = \frac{kqQ}{r_2} + \frac{1}{2}mv^2 \qquad \leftarrow \textbf{1 mark}$$

$$\frac{9.00\times10^{9}\left(1.6\times10^{-19}\right)\left(5.0\times10^{-6}\right)}{1.0} = \frac{9.00\times10^{9}\left(1.6\times10^{-19}\right)\left(5.0\times10^{-6}\right)}{3.0} + 0.5\left(1.67\times10^{-27}\right)v^2 \qquad \leftarrow \textbf{1 mark}$$

$$7.2\times10^{-15} = 2.4\times10^{-15} + 8.35\times10^{-28}v^2$$

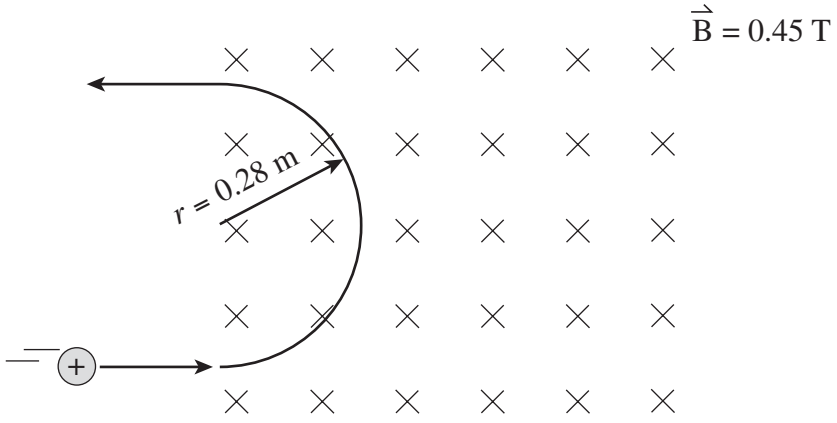
$$v = 2.4\times10^{6}\ \text{m/s} \qquad \leftarrow \textbf{1 mark}$$

A deuteron (charge $+e$, mass $2m_p$) is placed at the same starting position as the proton.
Explain why the speed of the deuteron at the 3.0 m mark is different than that of the proton.

The deuteron will have the same kinetic energy as the proton. (1 mark)
Because it has a larger mass than the proton, it has a smaller speed. (1 mark)

4. **(5 marks)**

A proton travelling at a high velocity enters a 0.45 T magnetic field and travels in a circular path of radius 0.28 m as shown.



What is the kinetic energy of the proton?

$$F_c = F_B$$

$$\frac{mv^2}{R} = qvB \qquad \leftarrow \textbf{1 mark}$$

$$\frac{mv}{R} = qB$$

$$\frac{1.67\times10^{-27}v}{0.28} = \left(1.6\times10^{-19}\right)(0.45) \qquad \leftarrow \textbf{1 mark}$$

$$v = 1.2\times10^{-7}\ \text{m/s} \qquad \leftarrow \textbf{1 mark}$$

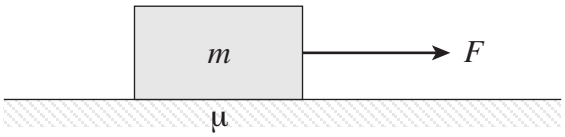
$$E_k = \tfrac{1}{2}mv^2 \qquad \leftarrow \tfrac{1}{2}\ \textbf{mark}$$

$$= \tfrac{1}{2}\times1.67\times10^{-27}\times\left(1.2\times10^{7}\right)^2 \qquad \leftarrow \tfrac{1}{2}\ \textbf{mark}$$

$$= 1.2\times10^{-13}\,\text{J} \qquad \leftarrow \textbf{1 mark}$$

5. **(5 marks)**

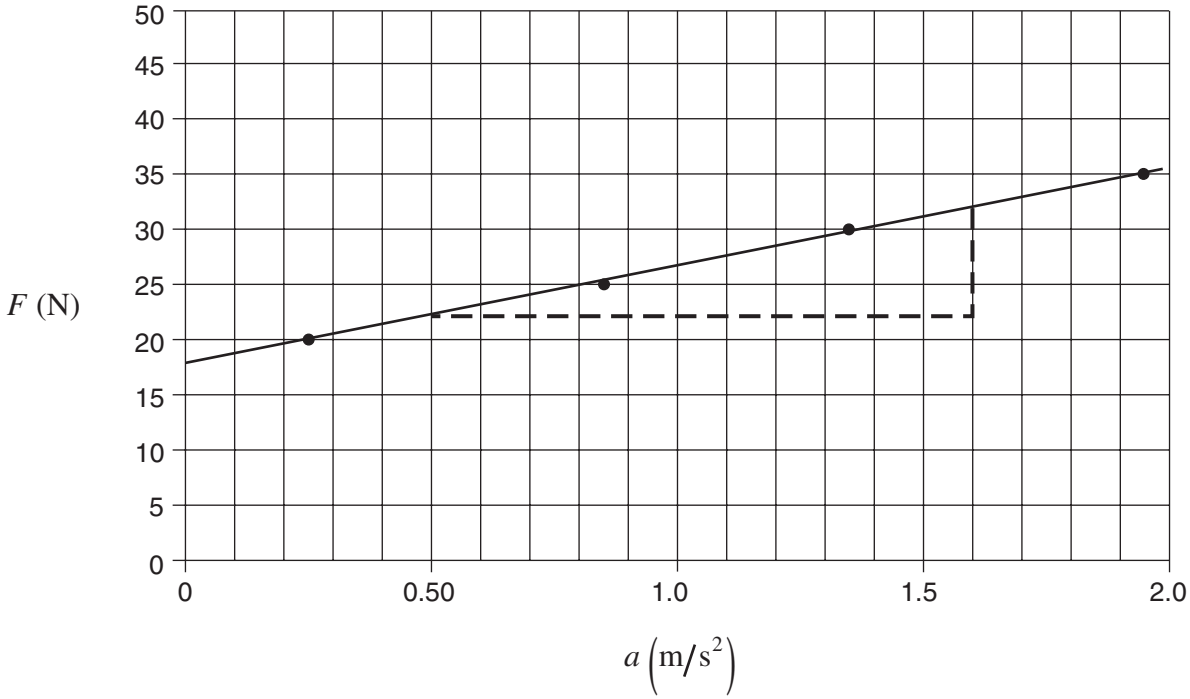
A force (F) was used to pull a wooden block across a floor as shown below.



The size of the force was varied and the data table below shows the size of the force and the block's resulting acceleration.

F (N)	$a\left(\text{m/s}^2\right)$
20	0.25
25	0.85
30	1.35
35	1.95

Plot the data on the graph below and draw a line of best fit. Extend the line back to the 'y' axis so that you have a y-intercept point and determine the slope of the line.



(1 mark)

$$slope = \frac{10\ \text{N}}{1.1\ \text{m/s}^2}$$

$$= 9.1\ \text{kg} \qquad \leftarrow \textbf{2 marks}$$

Using your slope value and your *y*-intercept value from the graph, determine the coefficient of friction between the block and the floor.

$$F - F_{fr} = ma$$

$$F = ma + F_{fr}$$

$$y\text{-}intercept = F_{fr} = 17.5\ \text{N}$$

$$slope = mass = 9.1\ \text{kg}$$

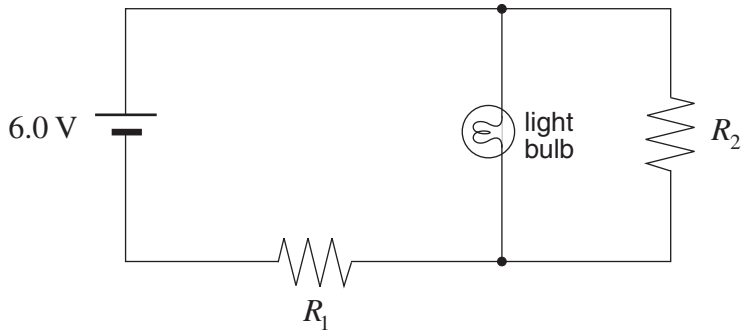
$$17.5 = \mu mg$$

$$17.5 = \mu(9.1)9.8 \qquad \leftarrow \textbf{1 mark}$$

$$\mu = 0.20 \qquad \leftarrow \textbf{1 mark}$$

6. **(4 marks)**

A student initially sets up a circuit containing two resistors and a light bulb, as shown.



The student notes the brightness of the light bulb. Using principles of physics, explain what happens to the brightness of the light bulb when resistor R_2 is removed.

Removing R_2 increases the resistance of the circuit (1 mark).
The current through the circuit is therefore decreased (1 mark).
There is therefore a reduced voltage drop across R_1 (1 mark).
Therefore the voltage drop across the bulb is increased and therefore brighter $\left(P = V^2/R\right)$ (1 mark).

END OF KEY