NOVA SCOTIA EXAMINATIONS

PHYSICS 12

JUNE 2002

MARKING GUIDE

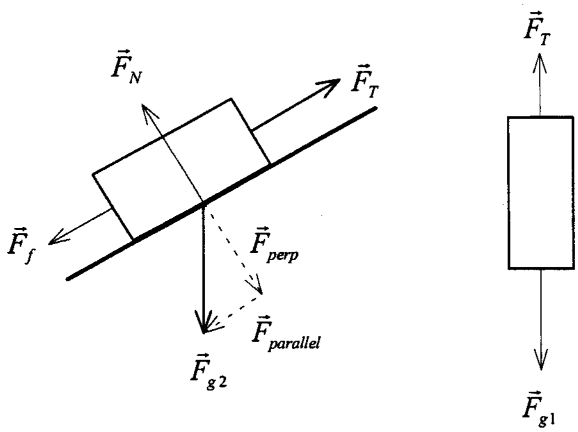
NOVA SCOTIA
Department of Education
Testing and Evaluation

June 2002 Physics
Multiple Choice Answers
Total Value 40

	SCO		SCO
1. C	ACP 1	21. A	328–4
2. C	ACP 1	22. B	ACP–3
3. A	ACP 1	23. C	ACP–3
4. C	326–3	24. C	ACP–3
5. A	326–3	25. B	328–6
6. A	326–3	26. A	328–7
7. C	325–6	27. B	328–6
8. C	325–6	28. B	328–7
9. D	325–6	29. D	328–9
10. B	325–12, 13	30. B	328–9
11. C	325–12, 13	31. B	328–9
12. A	325–12, 13	32. A	328–6
13. C	215–2	33. C	327–11
14. D	215–2	34. C	327–10
15. A	215–2	35. D	326–9
16. B	327–2	36. D	329–1
17. A	327–2	37. C	329–1
18. B	327–2, 327–4	38. C	329–3
19. B	327–2, 327–4	39. A	329–4
20. A	328–3	40. C	329–4

The solutions and point allocations shown are provided as a guide. Acceptable alternative solutions should be scored at the teacher's discretion, taking rounding into account.

41.



value: 2

$\vec{F}_{g1} = mg = (12.0 \text{ kg}) \times (9.80 \text{ m/s}^2) = 118 \text{ N}$

$\vec{F}_{parallel} = mg\sin\theta = (8.00 \text{ kg})(9.80 \text{ m/s}^2)(\sin 30°) = 39.2 \text{ N}$ **value: 1**

$\vec{F}_f = \mu mg\cos\theta = (0.200)(8.00 \text{ kg})(9.80 \text{ m/s}^2)(\cos 30°) = 13.6 \text{ N}$ **value: 1**

$F_{NET} = 118 \text{ N} - 39.2 \text{ N} - 13.6 \text{ N} = 65.2 \text{ N}$ **value: 1**

$a = \dfrac{\vec{F}_{NET}}{m} = 65.2\text{N} / 20.0 \text{ kg} = 3.26 \text{ m/s}^2$ **value: 1**

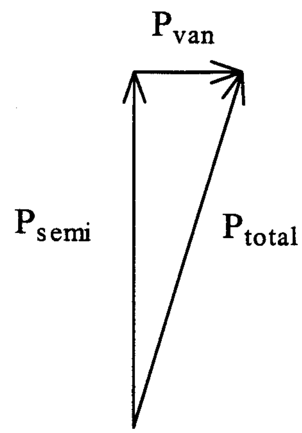
42. $\sum\tau = \sum\tau$ Note: since there is no commonly accepted expression, value should be given for an acceptable statement of the equality of clockwise and counterclockwise torques. **value: 1**

$(75.0\text{ kg})(9.80\text{ m/s}^2)(d) = (65.8\text{ kg})(9.80\text{ m/s}^2)(1.00\text{ m}) + (42.5\text{ kg})(9.80\text{ m/s}^2)(2.00\text{ m})$ **value: 1**

$d = 2.00\text{ m}$ **value: 1**

43. A) $p_{van} = m_{van}v_{van} = (2100\text{ kg})(30.0\text{ m/s}) = 6.3 \times 10^4\text{ kgm/s}$ **value: 0.5**

$p_{semi} = m_{semi}v_{semi} = (21000\text{ kg})(10.0\text{ m/s}) = 2.1 \times 10^5\text{ kgm/s}$ **value: 0.5**



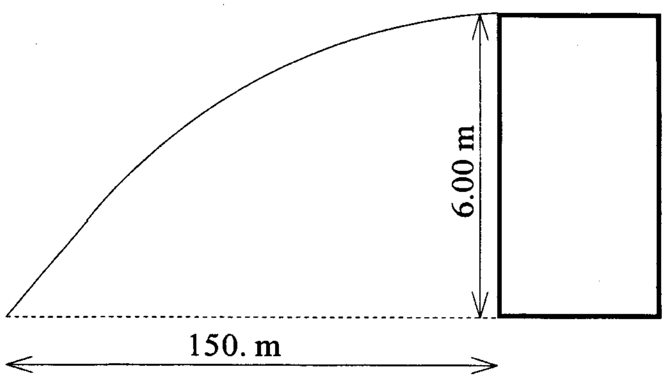
value: 2

B) $p_{total} = \sqrt{6.3\times10^4\text{kgm/s}^2 + 2.1\times10^5\text{kgm/s}^2} = 2.2\times10^5\text{kgm/s}$ **value: 1**

$v = \dfrac{p_{total}}{m_{total}} = 2.2 \times 10^5\text{ kgm/s} / 23000\text{ kg} = 9.6\text{ m/s}$ **value: 2**

$\theta = \tan^{-1}(6.3 \times 10^4\text{ kgm/s})/(2.1 \times 10^5\text{ kgm/s}) = 17°$ E of N **value: 1**

44.

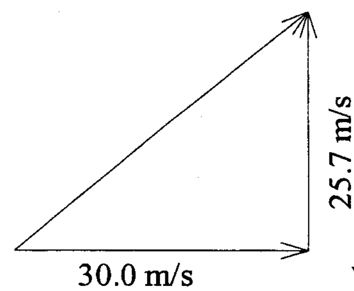


GIVEN:

$d_x = 150.\ \text{m}$ $\quad$ $d_y = 6.00\ \text{m}$

$t = 5.00\ \text{s}$ $\quad$ $g = -9.80\ \text{m/s}^2$

$t = 5.00\ \text{s}$



value: 1

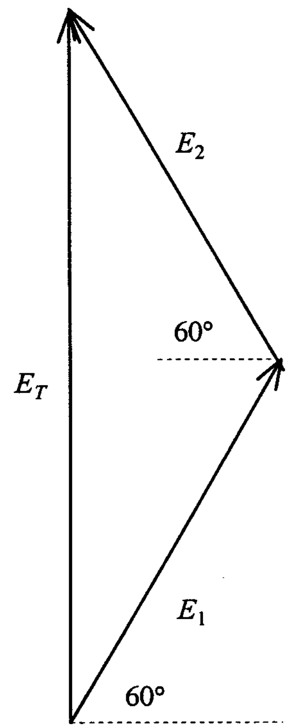
$v_x = d_x / t = 150.\ \text{m}/5.00\ \text{s} = 30.0\ \text{m/s}$, toward the building **value: 1**

$d_y = v_y t + \frac{1}{2} g t^2 \qquad v_y = \dfrac{d_y - \frac{1}{2} g t^2}{t} = \dfrac{6.0\ \text{m} - \frac{1}{2}(-9.80\ \text{m/s}^2)(5.00\ \text{s})^2}{5.00\ \text{s}} = 25.7\ \text{m/s}$, up **value: 2**

$v_{inst} = \sqrt{v_x^{\,2} + v_y^{\,2}} = \sqrt{(30.0\ \text{m/s})^2 + (25.7\text{m/s})^2} = 39.5\ \text{m/s}$ **value: 1**

$\tan\theta = \dfrac{v_y}{v_x} = \dfrac{25.7\text{m/s}}{30.0\text{m/s}} = 0.857$, $\quad \theta = 40.6°$ up from horizontal **value: 1**

45. A)



value: 2

B) $E = \frac{kq_1}{r^2} = \frac{(9.0\times10^9\text{Nm}^2/\text{C}^2)(4.20\times10^{-5}\text{C})}{(0.500\text{m})^2} = 1.51\times10^6\text{N}$ value: 2

$$\sum E_x = E_{x1} - E_{x2} = 0$$

$\sum E_y = E_{y1} + E_{y2} = 2E_{y1} = 2(1.51\times10^6\text{ N/C}\sin60.0°) = 2.62\times10^6\text{ N/C}$ directed to the top of the page.

value: 2

46. $F_E = \frac{kq_1q_2}{r^2} = \frac{(9.0\times10^9\text{Nm}^2/\text{C}^2)(4.0\times10^{-6}\text{C})(6.0\times10^{-6}\text{C})}{(0.05\text{m})^2} = 86.4\text{N}$ repulsive force

value: 2

47. A) $R_1 + R_2 = 2.0\ \Omega + 4.0\ \Omega = 6.0\ \Omega$ **value: 1**

$$\frac{1}{R_{1,2,3}} = \frac{1}{R_{1,2}} + \frac{1}{R_3} = \frac{1}{6.0} + \frac{1}{12} = \frac{3}{12}$$

$$R_{1,2,3} = 4.0\Omega$$

value: 1

$R_T = R_{1,2,3} + R_4 = 4.0\ \Omega + 5.0\ \Omega = 9.0\ \Omega$

value: 1

B) $I = \frac{V}{R} = \frac{12\text{V}}{9.0\Omega} = 1.3\text{A}$ **value: 2**

C) at R_4, $V = IR = 1.3\text{A} \times 5.0\Omega = 6.5\text{V}$ **value: 1**

In the parallel branches, $V = 12\text{V} - 6.5\ \text{V} = 5.5\ \text{V}$ **value: 1**

In the $R_{1,2}$ branch, $I = \frac{V}{R} = \frac{5.5\text{V}}{6.0\Omega} = 0.92\text{A}$ Therefore, $R_2 = 0.92\text{A}$ **value: 1**

NOTE: other solutions may result in different answers due to rounding. R_2 could be 0.87 A.

48. Since the Compton effect demonstrates that photons have momentum, it supports a particle model for the nature of light. **value: 2**

49. $\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}\text{Js}}{(0.32\text{kg})(13\text{m/s})} = 1.6 \times 10^{-34}\text{m}$. This wavelength is much too small to be visible since light waves are in the order of 10^{-7} m. **value: 2**

50. A) mass of He nucleus: 6.6443×10^{-27} kg

mass of constituent particles: 2 protons = 3.3470×10^{-27} kg

2 neutrons = 3.3498×10^{-27} kg

total particle mass = 6.6968×10^{-27} kg

mass defect = 6.6968×10^{-27} kg - 6.6443×10^{-27}kg = 5.2500×10^{-29} kg **value: 2**

B) $E = mc^2$ = $(5.2500\times10^{-29}$ kg$)(3.00\times10^{8}$ m/s$)^2$ = 4.72×10^{-12} J, or 2.95×10^{7} eV **value: 1**

C) 2.95×10^{7} eV / 4 nucleons = 7.38×10^{6} eV/nucleon, or 1.18×10^{-12} J/nucleon **value: 1**

51. Examples

A major accident could result in the release of a large quantity of radioactive gas that would be airborne over a large area, as well as intense radiation in the immediate area of the reactor. This would result in death by radiation sickness in the short term and cancers in the longer term, as well as undeterminable genetic alterations. There is a very low risk, but the consequence could be catastrophic.

The mining of uranium and the disposal of spent fuel pose significant risks in the temporary and long-term storage of the materials, as well as their transportation from mine to reactor to storage facility. The short-term risk of a transportation incident is greater than the long-term risk associated with storage.

Risks become more serious in countries that are not monitored as closely as Western nations. There is potential for development of nuclear weapons, as in Pakistan. Again, the risk is small, but the potential consequence is immense.

Reactors are costly to build, fuel, and maintain, therefore the energy produced is not significantly cheaper than alternatives. Dependance on nuclear facilities decreases research on more benign sources, such as wind and solar power. This is a consequence more than a risk.

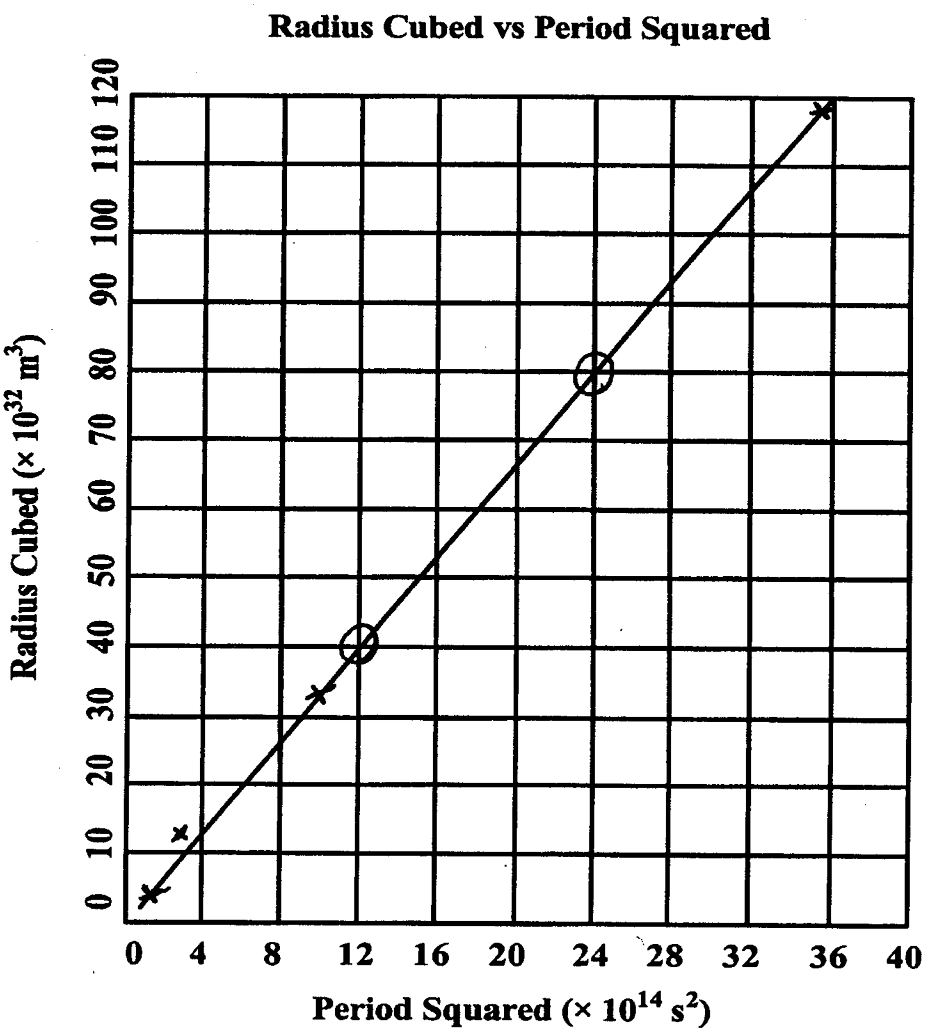
value: 4 (2 for each of two examples)

Planet	R (m)	T (s)	R^3 (m^3)	T^2 (s^2)
Mercury	5.79×10^{10}	7.60×10^{6}	1.94×10^{32}	5.78×10^{13}
Venus	1.08×10^{11}	1.94×10^{7}	1.26×10^{33}	3.77×10^{14}
Earth	1.49×10^{11}	3.16×10^{7}	3.31×10^{33}	9.99×10^{14}
Mars	2.28×10^{11}	5.94×10^{7}	1.19×10^{34}	3.53×10^{15}

52. A)

value: 1

B)



value: 2

C) The slope is 3.33×10^{18} m^3/s^2. The best fit line is the diagonal of a space four blocks high and three blocks wide. Any two reasonable points used to determine the slope are acceptable.

value: 2

D) The slope is the constant (k) in Kepler's third law, in which $k = R^3/T^2$. It represents something experienced in common by the four planets, which helps determine their orbital motion.

value: 1

E) $$R^3 = \frac{Gm_s T^2}{4\pi^2}$$

value: 1

F) $$\frac{Gm}{4\pi^2} = \frac{(6.67\times10^{-11}\,\text{Nm}^2/\text{kg}^2)\times(1.98\times10^{30}\,\text{kg})}{39.5} = 3.33\times10^{18}\ \text{Nm}^2/\text{kg, or m}^3/\text{s}^2$$

value: 1

G) The calculated values are equal. From part E), $\frac{R^3}{T^2} = \frac{Gm_s}{4\pi^2}$.

If the fractions are equal, then the assumption that lead to the expression is valid. NOTE: It is not enough to simply demonstrate the equality. The student must explain how this equality supports Newton's assumption. **value: 2**