Physics HL P1 TZ1

2006 May

School Level 12th IB Diploma Programme

Board Exam

International Baccalaureate (IB Board)

Solved

IBO
IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

PHYSICS
HIGHER LEVEL
PAPER 1

Tuesday 9 May 2006 (afternoon)

1 hour

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

1. An object has an acceleration of $2.0\,\mathrm{m\,s^{-2}}$. Which of the following gives the change in the speed of the object after $7.00\,\mathrm{s}$ to the correct number of significant digits?

    A. $14\,\mathrm{m\,s^{-1}}$

    B. $14.0\,\mathrm{m\,s^{-1}}$

    C. $14.00\,\mathrm{m\,s^{-1}}$

    D. $14.000\,\mathrm{m\,s^{-1}}$

2. An object falls from rest with an acceleration g. The variation with time t of the displacement s of the object is given by
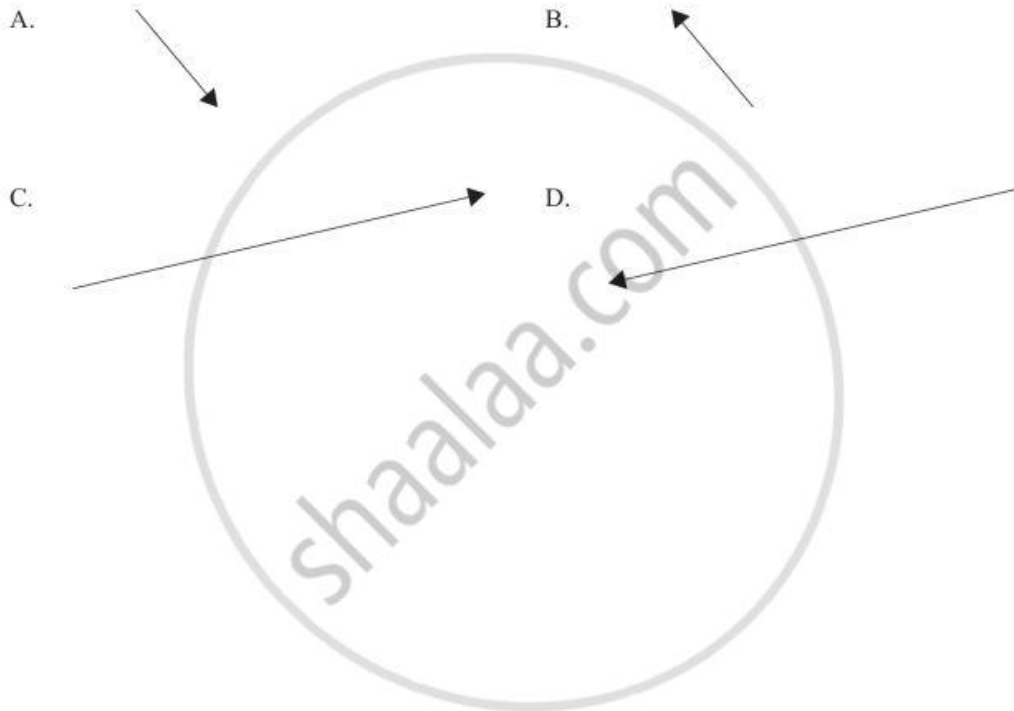
    $$s = \frac{1}{2}gt^2.$$

    The uncertainty in the value of the time is $\pm 6\%$ and the uncertainty in the value of g is $\pm 4\%$. The best estimate for the uncertainty of the position of the object is

    A. $\pm 5\%$.

    B. $\pm 8\%$.

    C. $\pm 10\%$.

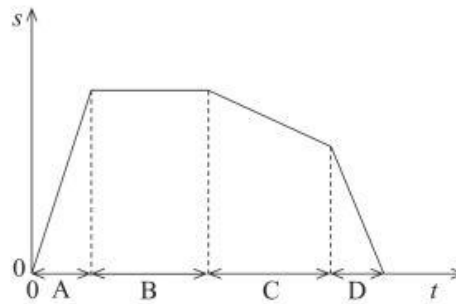   D. $\pm 16\%$.

3. The diagram below shows two vectors, **x** and **y**.


Which of the vectors below best represents the vector **c** that would satisfy the relation **c=x+y**?

A.

B.

C.

D.

4. The graph below shows the variation with time *t* of the displacement *s* of a car. In which time interval is the speed greatest?

5. An archer shoots an arrow at an angle to the horizontal. Air resistance is negligible. Which of the following graphs best represents the variation with time of the **horizontal component** of the arrow's velocity from the time it is launched to the time just before it hits the ground?
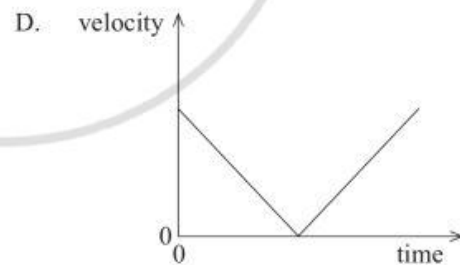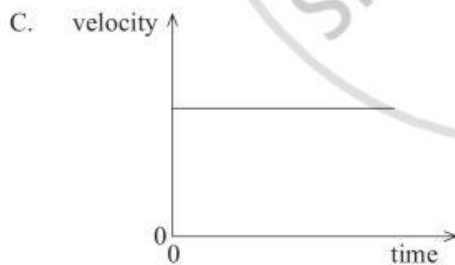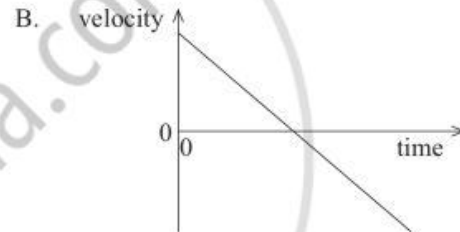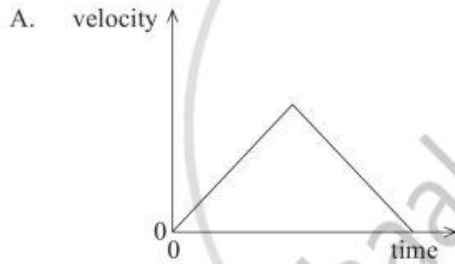
6. A block of mass m is pulled along a horizontal, frictionless surface by a force of magnitude F. The force makes an angle θ with the vertical.
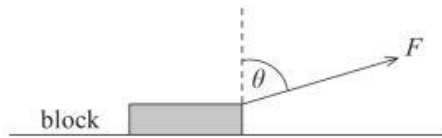
The magnitude of the acceleration of the block in the horizontal direction produced by the force F is

A. $\dfrac{F}{m}$.

B. $\dfrac{F \sin \theta}{m}$.

C. $\dfrac{F \cos \theta}{m}$.

D. $\dfrac{F \tan \theta}{m}$.

7. An object of mass m is initially at rest. An impulse I acts on the object. The change in kinetic energy of the object is

A. $\dfrac{I^2}{2m}$.

B. $\dfrac{I^2}{m}$.

C. $I^2 m$.

D. $2I^2 m$.

Turn over

8. A spring is compressed by a force F.
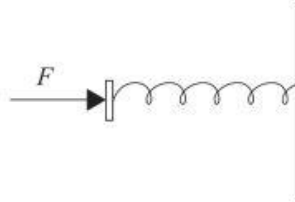
For a compression e, the force F is given by $F=ke$. When the compression force is removed, the spring returns to its original length in time t. The best estimate for the power developed by the spring during its expansion is

A. $\dfrac{ke}{2t}$.

B. $\dfrac{ke}{t}$.

C. $\dfrac{ke^2}{2t}$.

D. $\dfrac{ke^2}{t}$.

9. In Newton's universal law of gravitation the masses are assumed to be

A.   extended masses.

B.   masses of planets.

C.   point masses.

D.   spherical masses.

10. The acceleration of free fall of an object of mass m at the surface of Mars is a. The gravitational field strength at the surface of Mars is

A. a.

B. ma.

C. $\dfrac{a}{m}$.

D. $\dfrac{m}{a}$.

11. The gravitational potential at the surface of Earth is V. The radius of Mercury is about one third the radius of Earth. Earth and Mercury are spheres of the same density and the volume of a sphere is

$$\frac{4}{3}\pi r^{3}.$$

The gravitational potential at the surface of Mercury is

A. $\dfrac{1}{9}V$.

B. $\dfrac{1}{3}V$.

C. $3V$.

D. $9V$.

12. A satellite is in orbit about Earth. The satellite moves to an orbit closer to Earth. Which of the following correctly gives the change in the potential energy and the kinetic energy of the satellite?

|	change in potential energy	change in kinetic energy
A.	Decreases	Increases
B.	Decreases	Decreases
C.	Increases	Increases
D.	Increases	Decreases

Turn over

13. A brick is at rest on a slope. The slope makes an angle θ with the horizontal.
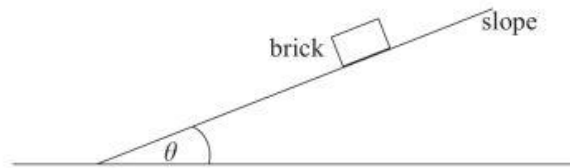
The angle θ is increased. The brick remains at rest. Which of the following correctly gives the changes in the friction force and the coefficient of static friction between the brick and the slope?

	Friction force	**Coefficient of static friction**
A.	Constant	Constant
B.	Constant	Increases
C.	Increases	Constant
D.	Increases	Increases

14. A ladder rests in equilibrium against a wall as shown.
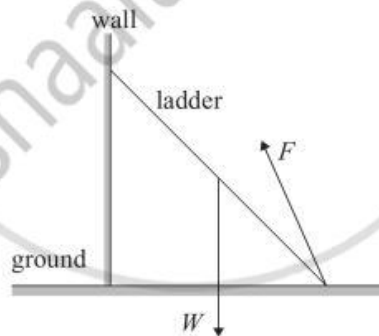
The weight of the ladder is W and the force acting on the ladder is F. Which of the following correctly shows the force of the wall on the ladder?
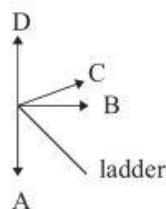
15. The internal energy of a solid substance is equal to the

    A.   average kinetic energy of the molecules.

    B.   total kinetic energy of the molecules.

    C.   total potential energy of the molecules.

    D.   total potential and total kinetic energy of the molecules.

16. Which of the following correctly shows the changes, if any, in the potential energy and in the kinetic energy of the molecules of a solid as it melts?

	Potential energy	Kinetic energy
A.	Decreases	Increases
B.	Increases	Stays the same
C.	Stays the same	Decreases
D.	Stays the same	Stays the same

17. Which of the following combinations of changes will produce the greatest increase in the theoretical maximum efficiency of a heat engine?

	Temperature of cold reservoir	Temperature of hot reservoir
A.	Increase	Decrease
B.	Increase	Increase
C.	Decrease	Decrease
D.	Decrease	Increase

Turn over

18. An operating refrigerator with its door open is placed in a thermally insulated room.
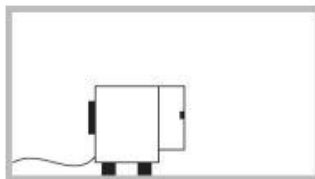

The refrigerator operates for a long period of time. Which of the following correctly gives the change in temperature and the entropy of the air in the room?

	Temperature	Entropy
A.	Increases	Increases
B.	Increases	Decreases
C.	Decreases	Decreases
D.	Decreases	Increases

19. Monochromatic light crosses the boundary between two media. Which of the following quantities is always the same for the light in both media?

A. Amplitude

B. Frequency

C. Speed

D. Wavelength

20. A source produces water waves of frequency 10 Hz. The graph shows the variation with horizontal position of the vertical displacement of the surface of water at one instant in time.
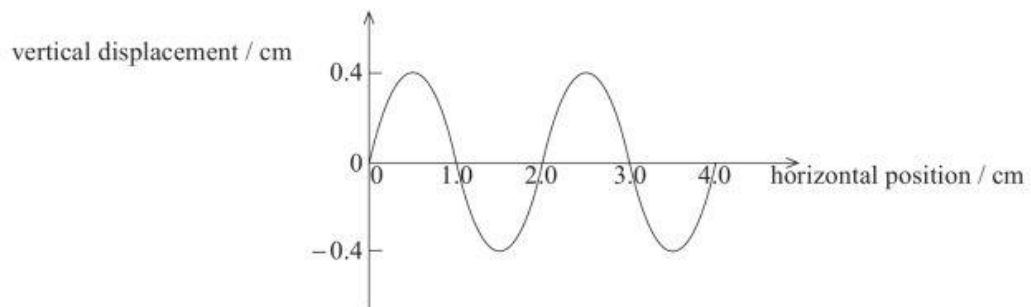
The speed of the water waves is

A. $0.20 \, cm \, s^{-1}$.

B. $4.0 \, cm \, s^{-1}$.

C. $10 \, cm \, s^{-1}$.

D. $20 \, cm \, s^{-1}$.

21. A bat approaches an insect of wing span length *d*. The bat emits a sound wave. The bat detects the insect if the sound is reflected from the insect.


reflected waves   incident waves
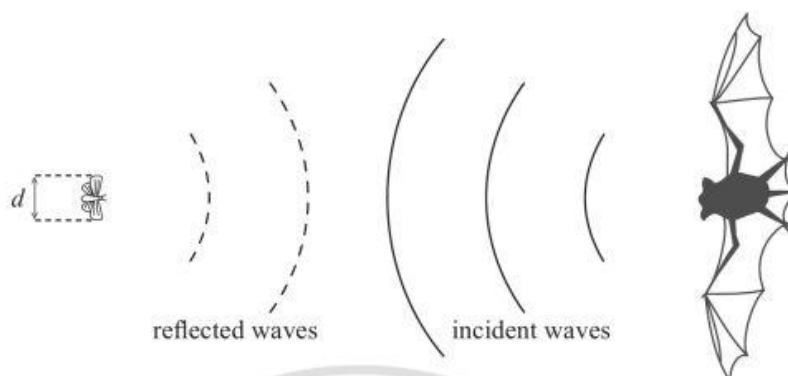
The insect will **not** be located if

A.   the insect's speed is less than the speed of the sound wave.

B.   the insect's wing beat frequency is greater than the frequency of the sound wave.

C.   the length *d* is much greater than the wavelength of the sound wave.

D.   the length *d* is much smaller than the wavelength of the sound wave.

22. A point source is moving at a constant speed in a straight-line towards the right and emits sound waves of constant frequency. The speed of the source is less than the speed of sound. Which of the diagrams correctly shows the wavefronts emitted by the source?

A.

B.

C.

D.
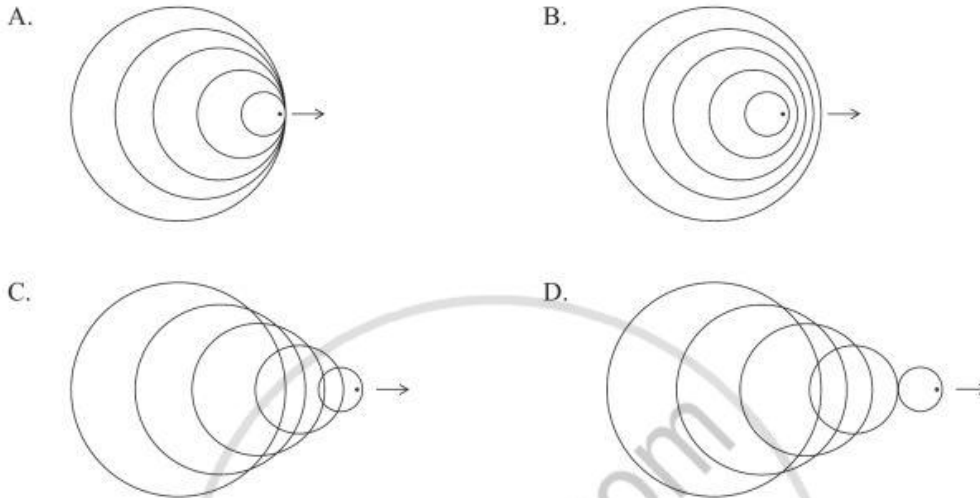
23. Two identical sirens are mounted on different cars. Car A is moving towards the observer and car B is moving away as shown below.

car B   observer   car A
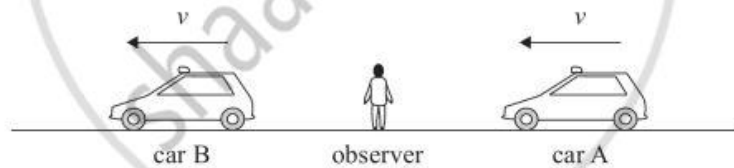
The observer measures the frequency of the sound emitted by car A as f_1 and by car B as f_2. The observer will hear beats of frequency

A. $f_1 + f_2$.

B. $\dfrac{f_1 + f_2}{2}$.

C. $f_1 - f_2$.

D. $\dfrac{f_1 - f_2}{2}$.

24. The diagram below shows the arrangement for a Young's double slit experiment.

single slit   double slit

S₁

monochromatic light source   ☼   S

S₂

not to scale
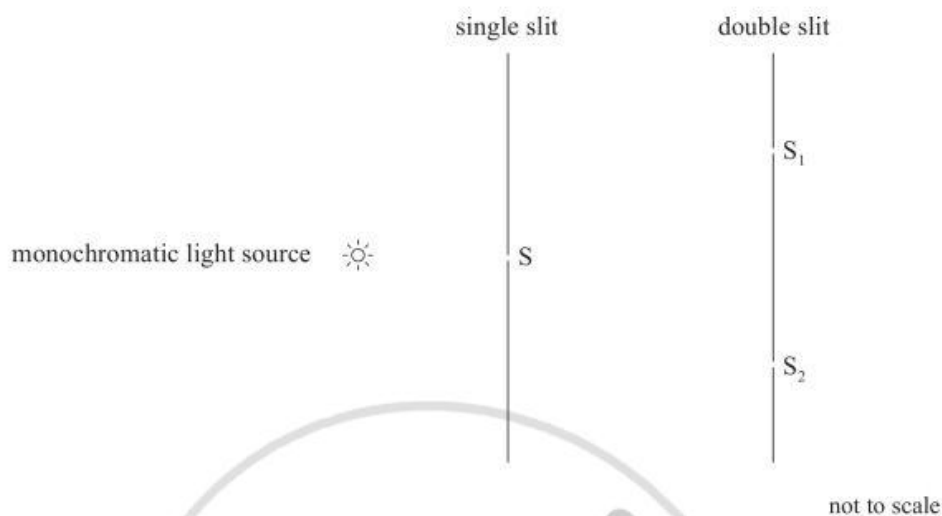
The function of the single slit is

A.   to direct the light towards S_1 and S_2.

B.   to ensure equal intensities of light at S_1 and S_2.

C.   to produce coherent light at S_1 and S_2.

D.   to reduce the intensity of light at S_1 and S_2.

25. Which of the following statements is **not** true?

A.   Electric charge is quantized.

B.   Electric charge is conserved.

C.   The force between two point charges is proportional to the sum of the charges.

D.   The force between two point charges is proportional to the inverse square of the separation of the charges.

26. The diagram below shows a charged rod R suspended by insulating strings. When a stationary rod S is placed nearby, rod R is attracted towards it.
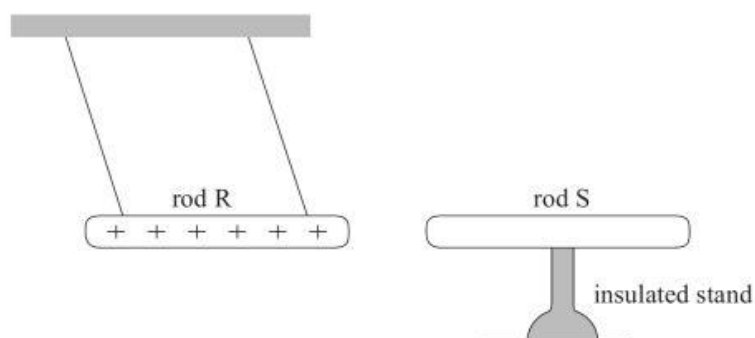
Consider the following statements regarding the possible nature of the rod S.

  I.   Rod S is charged.

  II.   Rod S is an uncharged insulator.

  III. Rod S is an uncharged conductor.

Which statement(s) can explain the attraction of rod R to rod S?

A. I only

B. II only

C. III only

D. I and III only

27. A proton of mass m and charge e is accelerated from rest through a potential difference V. The final speed of the proton is

A. $\sqrt{\dfrac{2Ve}{m}}$.

B. $\dfrac{2Ve}{m}$.

C. $\sqrt{\dfrac{Ve}{m}}$.

D. $\dfrac{Ve}{m}$.

28. Which of the following correctly describes the nature of electric potential and electric field strength?

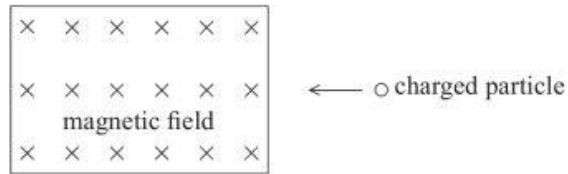|	Potential	Field strength
A.	Scalar	Scalar
B.	Scalar	Vector
C.	Vector	Scalar
D.	Vector	Vector

29. In the circuit shown below, the cell has negligible internal resistance.
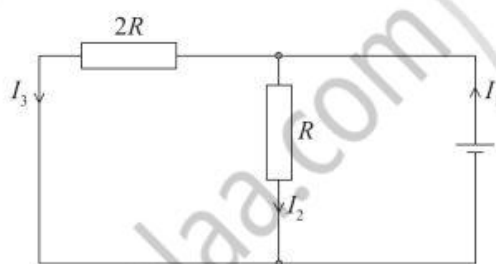
Which of the following equations is correct?

A. $I_1 = 2I_2$

B. $I_1 = 2I_3$

C. $I_2 = 2I_3$

D. $I_3 = 2I_1$

30. The diagram below shows a charged particle about to enter a region of uniform magnetic field directed into the page.


Which of the following correctly describes the change, if any, in the kinetic energy and the momentum of the particle in the magnetic field?

	Kinetic energy	**Momentum**
A.	Changed	Changed
B.	Changed	Unchanged
C.	Unchanged	Changed
D.	Unchanged	Unchanged

31. The diagram below shows two concentric loops lying in the same plane.

inner loop
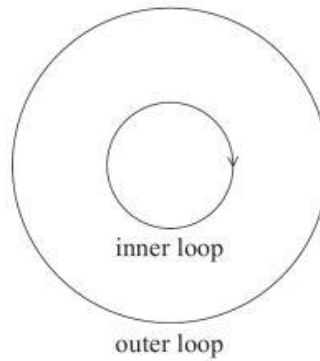
outer loop

The current in the inner loop is clockwise and increases with time as shown in the graph below.
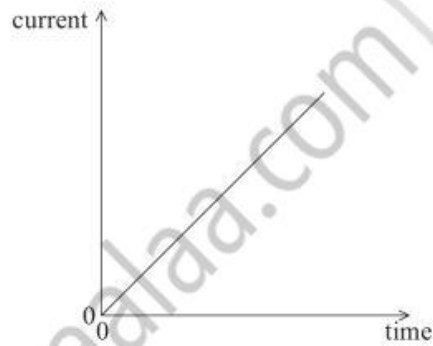
The induced current in the outer loop is

A.   constant in the clockwise direction.

B.   constant in the anticlockwise direction.

C.   variable in the clockwise direction.

D.   variable in the anticlockwise direction.

32. A light bulb is connected to an ac supply. The variation with time of the current is sinusoidal having a maximum value of 0.50 A. The r.m.s. current is

A. $\dfrac{0.50}{2}$ A .

B. $\dfrac{0.50}{\sqrt{2}}$ A .

C.   0.50 A .

D. $0.50\sqrt{2}$ A .

33. Light incident on a clean metal surface produces photoelectrons. The threshold frequency of the light is determined by

A.   the intensity of the incident light.

B.   the wavelength of the incident light.

C.   the nature of the metal surface.

D.   the maximum kinetic energy of the photoelectrons.

34. An electron of mass m_e and a proton of mass m_p are moving with the same speed. The de Broglie wavelengths associated with the electron and with the proton are λ_e and λ_p respectively.

The ratio $\dfrac{\lambda_p}{\lambda_e}$ is equal to

A. $\dfrac{m_p}{m_e}$.

B. $\dfrac{m_e}{m_p}$.

C. $\sqrt{\dfrac{m_p}{m_e}}$.

D. $\sqrt{\dfrac{m_e}{m_p}}$.

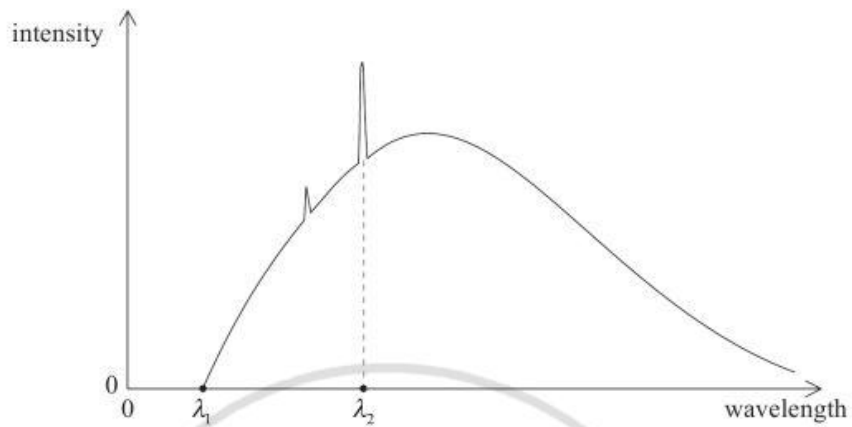35. The diagram below shows three energy levels of a certain atom.
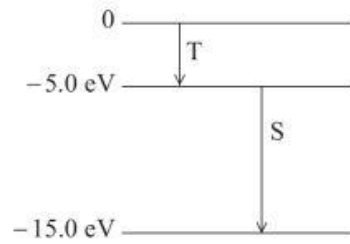
The photon associated with the energy change T has frequency f_T and the photon associated with the energy change S has frequency f_S.

The ratio $\dfrac{f_S}{f_T}$ is

A. $\dfrac{1}{3}$.

B. $\dfrac{1}{2}$.

C. 2.

D. 3.

36. The diagram below shows a typical X-ray spectrum produced in an X-ray tube.


The operating voltage across the X-ray tube is increased. Which of the following correctly gives the changes, if any, in λ_1 and λ_2?

	λ_1	λ_2
A.	No change	No change
B.	No change	Decrease
C.	Decrease	No change
D.	Decrease	Decrease

37. Which of the following identifies the **significant** interaction(s) between nucleons inside the nucleus?

A. Nuclear only

B. Coulomb only

C. Nuclear and Coulomb

D. Gravitational, nuclear and Coulomb

38. The following is a nuclear reaction equation.

$$_1^1\text{H} + {}_3^7\text{Li} \rightarrow 2\text{X}.$$
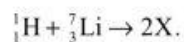
X is

    A.   an alpha particle.

    B.   a neutron.

    C.   a proton.

    D.   an electron.

39. The decay constant of two nuclei is λ. One nucleus decays within a time interval of one second. The probability of decay of the other nucleus in the same time interval is

    A.   0.

    B. $\dfrac{\lambda}{2}$.

    C. λ.

    D. 2λ.

40. An electron and an anti-electron undergo mutual annihilation. Which of the following does **not** have to be conserved?

    A.   Electric charge

    B.   Kinetic energy

    C.   Lepton number

    D.   Momentum

MARKSCHEME

May 2006

PHYSICS

Higher Level

Paper 1

2 pages

1.	A	16.	B	31.	B	46.	–
2.	D	17.	D	32.	B	47.	–
3.	B	18.	A	33.	C	48.	–
4.	A	19.	B	34.	B	49.	–
5.	C	20.	D	35.	C	50.	–
6.	B	21.	D	36.	C	51.	–
7.	A	22.	B	37.	C	52.	–
8.	C	23.	C	38.	A	53.	–
9.	C	24.	C	39.	C	54.	–
10.	A	25.	C	40.	B	55.	–
11.	A	26.	D	41.	–	56.	–
12.	A	27.	A	42.	–	57.	–
13.	C	28.	B	43.	–	58.	–
14.	C	29.	C	44.	–	59.	–
15.	D	30.	C	45.	–	60.	–